COMPUTING FOR BUSINESS AND HOME

INTERFACE AGE™

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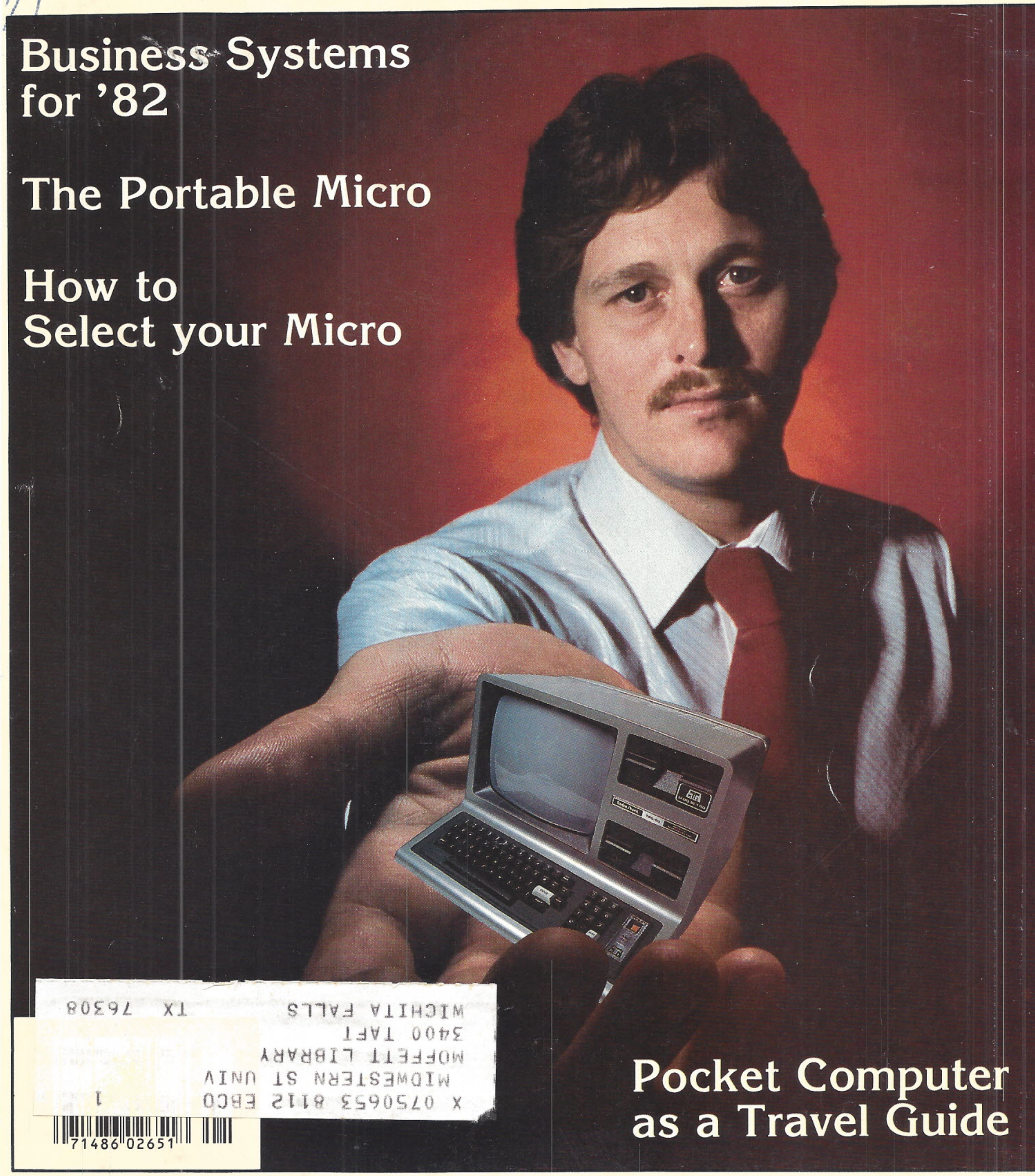

Business Systems for '82

The Portable Micro

How to Select your Micro

Pocket Computer as a Travel Guide

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Cromemco
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VOL. 7, ISSUE 1
SINCE DECEMBER 1975

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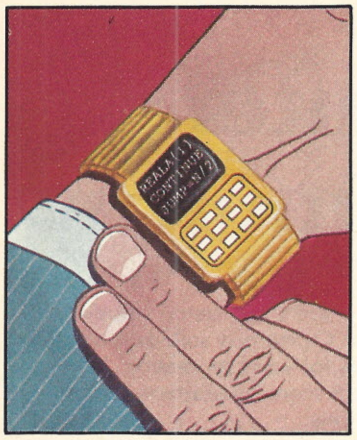
INTERFACE AGE™

COMPUTING FOR BUSINESS AND HOME APPLICATIONS

Computer Selection Tips 66



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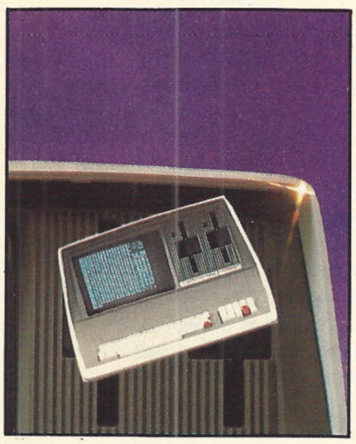

Business Systems for '82. 76

Cover model: Dave Barber
Computer supplied by Microcomputer Technology, Inc. Santa Ana, CA

FEATURES

COLUMNS

DEPARTMENTS

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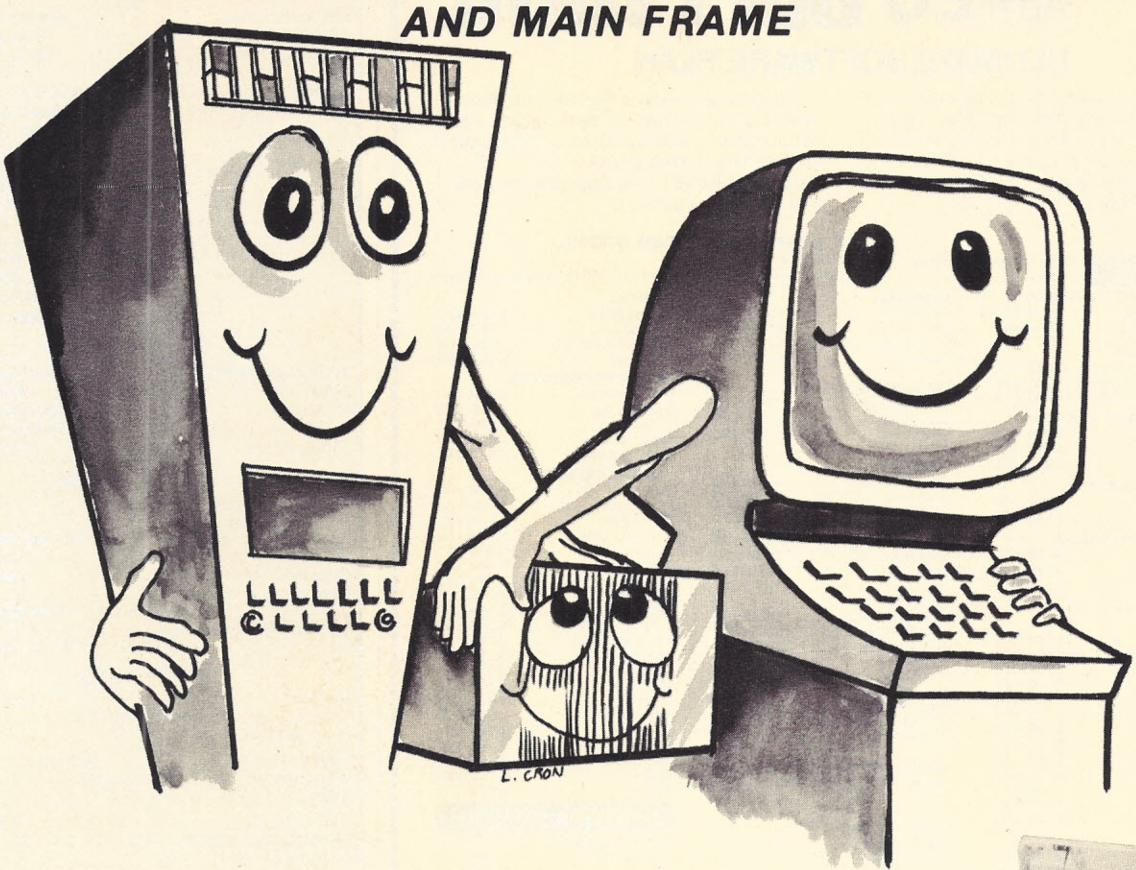
FRIENDSHIP

IS A RELATIONSHIP BETWEEN MICROCOMPUTER AND MAIN FRAME



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LSI/PDP-11	TU10/TM11	RT, RSX, RSTS, etc.
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SS50-based	N/A	OS-9
Ohio Scientific	N/A	OS-65U
RS232C	N/A	N/A
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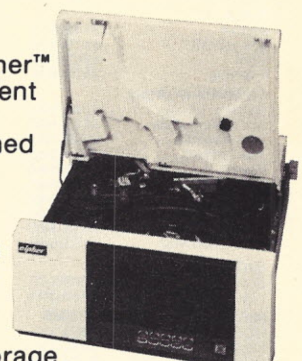

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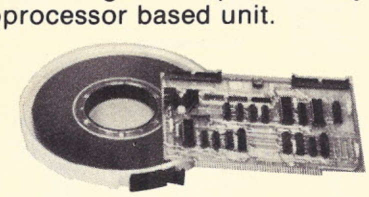

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EDITOR'S NOTEBOOK

Before the parade passes by

The secret is out and the parade is on. Hobby computers have arrived, and there is no greater evidence than the fact that an exclusive club of giant, old-line computer manufacturers has begun to take notice.

Xerox, Hewlett-Packard and IBM lead this parade, pretty much in that order (although the product announcements were but weeks apart). All are producing low-cost "personal" computers; all in the mold of microcomputers we have become familiar with in the past few years. The well-heeled newcomers can't take much credit for bold innovation. Their major contribution is the validation of an idea a lot of us held faith with all along: There's a place in this world for personally-owned computers.

The new computers are all amazingly similar in their most important design features. Remove their plastic or metal skins, and the similarities are far more remarkable than the differences. These machines are so much alike, in fact, that they all share the *same* operating system. Not so astoundingly, that operating system is our familiar friend CP/M, developed some years ago for hobby-class computers by Digital Research of Pacific Grove, CA. This fact is sure to have a far-reaching influence on the microcomputer market.

What's so important about the choice of CP/M? Any computer worthy of the name needs some sort of operating system. The purpose of this special kind of computer program is to orchestrate a system's various resources (memory, processor, disk drives, peripherals, etc.) so that useful work can be done. Whereas an operating system cannot by itself perform any meaningful computations for the computer owner, it creates the environment the applications programs need to work properly.

Applications programs include everything from word processors to general ledger packages to Star Wars games. Applications programs ask the questions, perform the computations and display (or print) the results. They are the most visible of the software that resides in a computer. But they won't run by themselves; they need an operating system to work. And—this is the crucial point—the melding of an applications program and its operating system is so intimate that one must be designed for the other. A payroll package designed for the Apple *will not* run on an IBM computer or one of the CP/M machines. Creators of applications programs are far more concerned with the idiosyncrasies of a computer's operating system than they are with those of the computer hardware itself.

We have seen CP/M emerge as one of the most popular of the microcomputer operating systems. The inevitable result is that a good portion of those applications programs that have been written in recent years will drop right into a CP/M computer.

Even beyond the operating system, much of the software for the new computers is borrowed—or "OEMed" from outside suppliers of the software products themselves. There was a time when these substantial corporations would barely consider an external source for products sold under their banner. These companies employ hundreds—sometimes tens of thousands—of top-flight programmers well capable of producing in-house versions (or improvements) of the programs shipped with their personal microcomputers.

But times are changing, nowhere so speedily as in the unkempt microcomputer business. Names like CP/M, Microsoft and VisiCalc—particularly VisiCalc—are household words in the marketplace into which these companies are planning their penetrations. That the names are likely to be *more* recognizable to certain prospective buyers may be hard to swallow by the giants. But it's the clever manufacturers who pay attention to the way the winds of trade are blowing.

So we see (as just one example) the HP 125 clothed in the CP/M operating system, spruced up with Microsoft's Basic-80, filled out with Lexisoft's Spellbinder and bejeweled by Software Art's VisiCalc—not at all a bad collection for openers. IBM's personal computer has a home for CP/M-86. The first of the giants to endorse this idea with product deliveries was Xerox with its CP/M-driven 820. The company has since extended CP/M's usefulness by adding it to the more capable Xerox 860.

Many will tell you that CP/M is technically not the best operating system, and far from the best that could be conceived for this class of computer. Certain individuals at Hewlett-Packard have, if fact, stated that if CP/M were an internally-developed product, it would need considerable "cleaning up" before it would meet their self-imposed strict standards for software quality. Nonetheless, CP/M was chosen as the HP 125's most important piece of software because of its established popularity—reason enough.

The simple inclusion of CP/M may be all that is necessary to ensure the success of the new computers from

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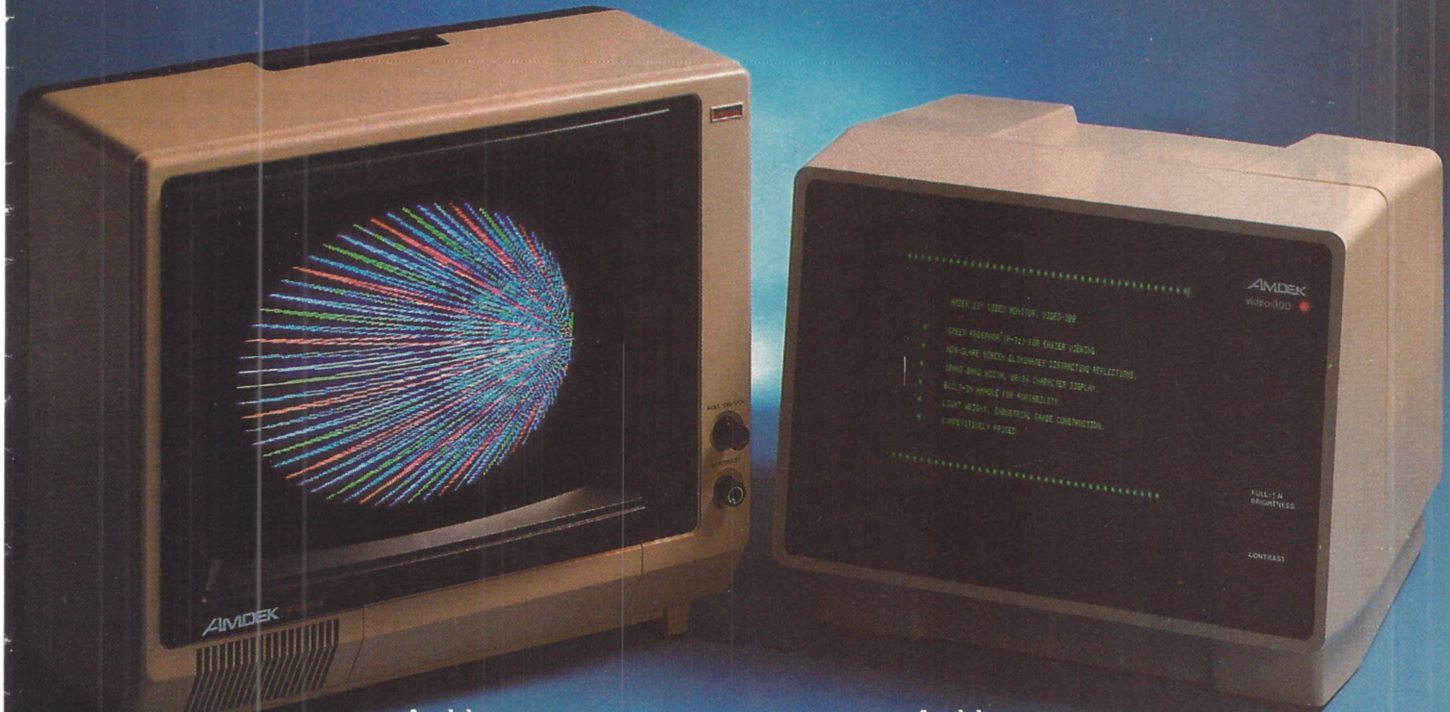

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EDITOR'S NOTEBOOK

IBM, Xerox and the others we have mentioned. At the very least, it is sure to telescope the time delay needed before these machines are performing useful jobs for their buyers. ***—TF***

Getting down to business

A funny thing happened to us on the way to finalizing our 1982 editorial plan: we realized that the character of our contributing authors was changing markedly. Our shift in emphasis to computer business applications has been in steady progress over the past couple of years. And the authors who submit articles for us are coming from the same arena.

Although the magazine is more staff-written than ever before, we still depend on good quality freelance article submissions to supplement our editorial content. We find that the majority of articles returned nowadays are rejected more for their subject matter than for their quality of execution. Most returned articles are aimed at the hobbyist/home computer buff that is no longer a major share of our readership. The articles that we are accepting for publication are primarily practical in nature, with solid information for the small businessman who uses a computer.

All things being relative, we are not ignoring the home computer buff or the diehard tinkerer who loves to program into the wee hours of the morning. In many cases, these two species of computer users overlap. So we still consider (and accept) a certain percentage of articles on home/hobbyist applications. But our editorial is primarily targeted to practical on-the-job applications and equipment.

We are encouraging small businessmen to submit articles. Share your experiences with us. It can only benefit other readers who are just getting started and need the voice of experience. How did you go about selecting the hardware? Which software proves to be the best for your particular line of work? How did you analyze your work flow requirements to decide which would best benefit from computerization?

Case studies of particular types of business—legal, medical, retail sales, stock market, educational, accounting and office functions—often result in highly practical articles that our readers respond to enthusiastically.

Our staff continues to focus our energies on writing and assigning articles of this sort. And freelance submissions add to this flow of valuable information —with first-hand knowledge as an added plus. ***—LS***

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LETTERS

Not too personal

Despite the ads calling their products "personal computers," I am convinced that the personal computer has not been invented yet.

Almost all the "personal computers" advertised are going to businessmen and upscale professionals. A product that starts at $1,500 and ranges to $5,000 is hardly a mass market "personal" product.

When computers with capabilities similar to today's $1,500 models can be bought for $300-500, we will be in the territory of the "personal" computer. If it has electronic mail and message capabilities and can access data banks, as most now can, it will spread like wildfire. And the company that produces it may change the world.

R. Dean Smith
Welry, PA

Big bite to chew

I urgently need information regarding CP/M. I have a Compucolor II from Intelligent Systems Corp., upon which I would like to run some of the software on today's market. Unfortunately, CP/M is not supported by Compucolor, so I am wiser but poorer.

I am wondering if CP/M is based on a set of defined conventions for storage use, I/O protocols, etc., so that I could develop code to emulate CP/M. How may I obtain the specs?

Bill Shively
Baltimore, MD

You are about to embark on an ambitious project, to say the least. CP/M is well covered in the Osborne CP/M User Guide *(Osborne/McGraw Hill, Berkeley, CA) and* The CP/M Handbook with MP/M *(Sybex, Berkeley, CA). It was developed by Digital Research, Pacific Grove, CA; they are sure to have the specifications you seek. (I.S.C. is also listed as an OEM vendor for CP/M.) "Developing code to emulate CP/M" is not a task we would advise for beginning programmers, however.* ***—TF***

Bugs in the Apple?

I own an Apple II computer, which I purchased in January 1980. I have few complaints about the hardware, itself, but a recent event has prompted me to write this letter.

In August 1980, the on/off switch on the power supply unit broke. Since it stuck on the off position, I couldn't just plug or unplug it; I had to take it in to be repaired. When I took the computer in, I was informed that Apple does not allow its authorized repair shops to repair the power supply unit, so it had to be replaced, at the cost of $201. I thought this was a bit expensive for what probably is a one dollar switch, but at the time, I didn't see any alternative, so it was repaired in this manner.

Since then, I've become less fearful of the hardware, so when I arrived home yesterday, to find that the replacement power supply unit also had a broken on/off switch, I decided to repair it myself.

After the removal of no less than 12 screws and two rivets, the power supply was opened (following, of course, the normal procedure of disconnecting the power cord, removal of cards, etc.).

I temporarily bypassed the switch by soldering the two wires going to it together and covering same with electrician's tape. Then I looked around a bit, and what I saw thoroughly disgusted me. Inside the power supply unit, inaccessible to anyone not so brave as I there is a blasted fuse! Replacing the whole power supply unit because of a blown fuse or faulty switch is rather extreme, wouldn't you say?

I am interested in finding out if others are experiencing the same difficulties, particularly owners of the Apple II Plus, where turning the on/off switch seems to be a way of life.

Does anyone know where I can get an on/off switch for an Apple II for a reasonable price?

Daniel K. Hollis
Box 192
Palmyra, WI 53156

A home computer system can easily cost $5,000-7,000. Thus, a lemon home computer is just as serious as a lemon car.

My Apple developed an intermittent failure. I took it to Rainbow Computing of Los Angeles, an Apple warranty repair station. They were unable to find the problem. Even though my machine was under extended warranty, they charged me $25 to tell me they could not find the problem, on the grounds that the problem allegedly did not occur while the machine was in the shop. (It did occur again as soon as I got my Apple home.) Rainbow's technician said this charge was an Apple policy, and that they would give me my money back if I could demonstrate the problem.

No rationalization of this charge was given, but the company's defense is not hard to imagine: The serviceman claims not to have seen the problem. Therefore the problem does not exist. Intermittent failures are among the most time consuming, and therefore the most expensive, problems. It's not ethical to get rid

of the worst problems just by saying they don't exist if the serviceman says he didn't see them. Furthermore, the customer is charged for daring to suggest the warranty covers hard problems.

I was luckier on the second try. Another warranty station (The Computer Store, Santa Monica) cured my "hallucination," at least so far. I might add that I am a professional programmer; I am used to giving reasonably precise descriptions of problems. If this is how I am treated, imagine the runaround the small businessman who knows little about computers can expect.

Richard Brandshaft
Los Angeles, CA

Additional medical software

As a systems analyst in the hospital industry, I found Rocky Smolin's article "Benefits of Medical Billing Packages" (IA Sep 81) extremely helpful to my understanding of the needs of small medical-business users. Are there other software packages on the market that respond as well as Basic Decisions to the requirements of physician group practices? How can I get information on them? I am looking to do some consulting with physicians on the needs they have for small business systems (both financial and patient care oriented systems).

Any additional information you can offer me would be greatly appreciated.

Janet Kaplan
Westchester County Medical Center
Valhalla, NY

Following are some leads on additional medical billing packages. I have not evaluated any of them and do not know if their capabilities will suit your application. However, it should give you a start on your software search. Contacts are: La Salle Computing, Norristown, PA; Services Unique, Dayton, OH; National Diagnostics and Data Corp., Hunt Valley, MD; E.D.P. Solutions, Bainbridge, OH; Hahn Enterprises, Grafton, WI; P & S Computer Services, Brewster, NY; and Prodigy Systems, Iselin, NJ. **—RS**

Watch your options

Re: "Programming Equipment Purchase Options" (IA Sep 81), I would add the following points.

First year depreciation is shown as $2,000. To compute double declining balance depreciation on $15,000 over 5 years would be (15,000/5) × 2 = $6,000 for the first year. Tax law does not allow reduction by salvage value when using double declining. This would increase our total net present value, making it more comparable to the lease option.

This is a financial cost analysis; the goal being to pick the financing option that costs the least. The cash inflows and maintenance figures have to do with the decision whether to buy a computer, not which financing option. Besides, they're both the same in both columns. These figures are not required in the analysis.

The article only presents buy or lease options. In the real world comparisons need to be made between buy, bank contract, nominal lease and tax oriented leases.

The article suggests that you use the bank prime rate as the discount rate, the 16% used in the example. This is not so. Each individual firm would use a different rate, projected return on working capital, or second best projected return on assets. As an example, take two firms each with one million dollars. Firm A invests all its funds in 5¼% passbook savings, while Firm B invests all its funds in commodity futures making an annual return of 32%. Clearly, Firm A should use its own funds, Firm B should use other people's money. Placing bank prime rate into the program would not come to these conclusions.

Bruno Caprez
Spokane, WA

Fuzzy examples

Congratulations! You've hit on the best topic available with Bob McElwain's column on pocket computers. I hope that it continues indefinitely.

After buying a TRS-80 pocket computer, printer and cassette interface and the Minisette-9 tape recorder, I picked up the Personal Finance, Games and Civil Engineering program packages. I've been using them for a month and a half. Radio Shack will not document *anything* properly. If McElwain feels that the computer manual is bad, he should see the program instruction manuals. The printing is clear and the illustrations are neat, but the examples are not properly explained.

Larry Marschall
San Jose, CA

Which Pascal is best?

Would you kindly give me your advice regarding implementation of Pascal on Z80-based microcomputers? I am aware of some of Alan R. Miller's articles on the subject, but am uncertain of how to compare some of the unreviewed versions. In particular, I am interested in your opinion of North Star Pascal, which is a UCSD implementation, now available in a new version, and Pascal/Z which was favorably reviewed in comparison with UCSD Pascal.

My interest is in learning and implementing a fair-sized version. In my learning stage, I would be more interested in specific error messages and debugging aids than in speed, although eventually I might need more speed to implement some graphics routines. I am using a North Star Horizon II with 56K RAM. I expect to purchase CP/M when verison 3 comes out. Do you think I should avoid North Star Pascal because of the advantages of running Pascal under CP/M?

John Silver
New York, NY

The new features of CP/M 3 take up room, but don't do much for single terminal users. I think that version 2.2 will prove to be satisfactory. If you are interested in easy debugging (i.e., development speed) rather than execution speed, I would recommend Pascal/M.
—ARM

Reader interface

The Atari personal computers have just been released in Australia and we intend to start a users group. We would like to correspond, exchange ideas and purchase software.

Gerald C. McCaughey
Box 246
Northcote, Victoria
Australia 3070

My computer, the 16K Atari 400 is relatively new in Hong Kong. To my knowledge, there are still no users' groups here for Atari 400. I would like to correspond and swap ideas and programs with other users.

Johnny Kam
11 Ground Floor, Block 33
Lower Wong Tai Sin Estate
Kowloon, Hong Kong

Free fixes are available for Ramware APL-80 version 3.0 system.

For those who are using this system and would like to receive bug fixes for 'reshape' and '>update', send a stamped self-addressed envelope.

APL
Box 55
Ardsley, NY 10522

For the record

In the article "Micros Approach Mini Capability" (IA Nov 81), the price for the Mercator MBS 4000 system, with 128K RAM, 20M-byte disk, 300 lpm printer and six stations, should have been listed as $46,100.

UPDATE

Micro training system for deaf is implemented

Some unusual opportunities are opening up for handicapped children at the American School for the Deaf, W. Hartford, CT. A microcomputer training system was donated by Computer Systems Research of Avon, CT. It is being used in an exploratory program of computer-assisted education for tenth, eleventh and twelfth graders who are either deaf or have impaired hearing.

Use of the system in six of ASD's math classes last spring helped 48 students to do drill exercises in subjects ranging from basic arithmetic to trigonometry. Plans call for its use in other courses as well, beginning this fall. The students have also learned to enter data

and control it, and some have even acquired basic skills in programming in just a few weeks' time.

The Trainer-3000 system interacts with the student, letting him enter one answer and indicating whether the answer is right or wrong. "The kids love it," says Dan Polansky, who teaches the students. "It's giving them an opportunity to think for themselves, and also helping them to learn how to be independent."

The program has also aroused the curiosity of other staff people at the school who are finding that the computer can be useful outside the classroom as well for such tasks as computing student averages and preparing report cards.

In addition, it has opened the administration's eyes on the value of the computer in educating the handicapped. As ASD Executive Director Winfield McChord Jr. says, "It is helping us to pinpoint those children with abilities to work in the data processing field, who might otherwise never have such opportunities." He pointed out that the program will be beneficial in placing the students in jobs after they graduate.

That's the way the bubble bursts

Problems with the use of bubble memory in the U.S. have been with price —not field performance—according to a recent industry study by Venture Development Corp., Wellesley, MA. Customers with special requirements for ruggedness, small size, light weight and super-reliability have been delighted with the performance, and are willing to live with the price. The mass market for computer related memories cannot stand the cost, however. Bubble prices are falling farther and farther behind prices of both disks and RAMs.

The VDC report explains that the problems have been more technical than marketing. Yields have been lower than anticipated, and costs have not been reduced as expected. Because prices did not fall as anticipated, volume failed to develop, and a chicken-and-the-egg non-performance pattern developed. Although there are needs for bubbles, which override price considerations in applications such as numerical controls and portable terminals, the volumes are not high enough to permit massive cost reductions.

In Japan, with the emphasis on reliability, bubbles are doing better. The Nippon T and T Co. has been ordering bubble devices in sizable quantities to replace fixed disks, giving impetus to the Japanese bubble industry. Government support and cooperation among bubble device makers has characterized the Japanese industry, rather than the unrestrained competition in the U.S. Leading U.S. producers have not been sufficiently convinced that the bubble is a money maker to make solid investments. These doubts produced a self-fulfilling prophecy of failure.

Organization formed for software authors

A group of Minnesota software authors has seen the need to pool its resources in a bid for better relations with software publishers.

Rapid growth of the computer industry has changed the way software publishers relate to their authors, according to Stan Gotlieb, spokesperson for the Computer Writers Assoc. "In the past, publishers were small. The author dealt with a top level decision-maker. Now these publishers are large corporations, and the author deals with an editor, three or four layers from the top. The original contract the author signed was a page or two of relatively plain language. The contract before the author today is several pages of close-typed legalese. These and other changes are frustrating, and there is little the author can do about them. What is needed is a computer-writers' professional association," Gotlieb asserted.

Gotlieb feels that computer writers

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need standardized contract language, retained legal counsel, published standards on plagiarism, and a regular newsletter. "New authors need advice on how to break into the industry," he explains, "Established writers need to learn more about their rights. A data bank should be established, so that members with similar interests or problems could find each other more easily. Regular, structured gatherings should be held where writers set the agenda."

Gotlieb invites interested parties to write to the association at P.O. Box 6312, Minneapolis, MN 55406.

Remote dial-up diagnostics service is demonstrated

A capability that permits a service engineer in Hackensack, NJ to dial into a customer's data communications network anywere in the U.S. and instantly diagnose a failure was recently demonstrated by Timeplex, Inc., Rochelle Park, NJ. The unique capability—called remote dial up diagnostics—ensures greater system uptime, cuts costs associated with service calls and reduces the need for expensive test equipment.

In an on-line demonstration at the New York Hilton Hotel, a service engineer, using a portable terminal, dialed into the University of Illinois' library computer system in Chicago, IL. The system consists of an IBM 370 model 168 computer, 300 terminals, 100 printers, over 100 modems and 60 Timeplex series II Microplexer statistical multiplexers/data concentrators. Two data channels at the university's computer center had been deliberately brought down for demonstration.

The Timeplex service engineer accessed the network via the Supervisory Port of the series II Microplexer. The Supervisory Port is an independent data channel that functions as a window into the system to add high level control, monitoring and diagnostics capabilities to a Microplexer network.

The engineer immediately isolated the faults and university technicians brought the channels back on line. In addition, the problem was diagnosed without interfering with any other channel in the system. Generally, the dial-up diagnostics are done from Timeplex's field service headquarters in Hackensack, NJ. The demonstration showed that it can be done from any location via a portable terminal by a trained technician.

Forth used to discover huge outer space void

A recent discovery by astronomers of an immense hole in the universe, large enough to encompass 2,000 galaxies the size of our Milky Way, was brought about with the help of the Forth programming methodology.

Astronomers at Arizona's Kitt Peak National Observatory and Mount Hopkins Observatory set out to survey the large-scale structure of the universe, using Forth to position their telescopes and to transcribe telescopic images into computer terms. The hole they discovered during their two-year study, which measures 300 million light years in diameter, could be enough evidence to demand revision of our current theories on how the universe evolved, according to Dr. Garry Mechler, spokesman for the Kitt Peak Observatory.

"A Forth-based data acquisition unit called an IIDS (Intensified Image Director Scanner) transfers the telescopic images onto computer tape," Mechler said. "After the images are transferred onto tape, we then work with computer analysts to chart the actual position of the stars in the universe."

Prior to the availability of the Forth-based IIDS unit, astronomers had never noticed the huge void in the universe because galaxies are in front of it as well as behind it. Normal observation allows only a two-dimensional view of the nighttime sky. A measurement process in which astronomers use the various colors emitted from stars to determine their relative distances is aided by the IIDS's ability to pinpoint a color's proximity to the red end of the spectrum.

The Forth language, adopted in 1976 by the International Astronomical Union as a standard language, is widely used among astronomers around the world.

Company offers third-party software for programmable calculators

Building on the success of HP Plus, Hewlett-Packard Co. has launched a program to help sell third-party software for its programmable calculators.

Under this newest addition to HP Plus, called the Software Supplier Program, HP will help qualified third-party software writers sell programs by promoting them through a comprehensive catalog to customers and dealers. The catalog contains descriptions and how-to-order information for all HP-41 programmable-calculator software written by HP *and* outside sources.

"Third-party software writers, dealers and end users all will benefit from the program," said Jack Peters, HP's software supplier manager for calculators. "Software suppliers get HP's marketing force behind them; dealers get more solutions to sell; and an easy-to-use

comprehensive catalog means HP-41 owners get more dependable programs," Peters said.

Likely candidates for this program are software suppliers for HP programmable calculators, HP computers and non-HP computers.

Prestel users can now talk to each other

Users of British Telecom's Prestel, the world's first public videotex service, are now able to send messages directly to one another, as well as call up information from the system's central computer. The recently introduced Mailbox, an electronic mail service, is said to expand the system's potential. It was introduced to U.K. subscribers last September.

The user calls up a "mailbox frame" on the computer and, with his regular Prestel terminal, "writes" his message and the account number of the addressee. The information appears on the screen of his adapted television set. The message is stored by the computer. When the addressee switches on Prestel, he is advised of the message. He can receive it immediately or call it up from storage later. The system is expected to be of particular benefit when the message sender and receiver are in different time zones.

An alphabetical directory of users with names, abbreviated addresses and account numbers is available on Prestel itself. Directory entries are free and are published only at the request of the customer.

Employing telephone lines as its communications medium, Prestel has more than 12,000 users in the U.K. with access to about 185,000 computer-stored "pages," supplied by more than 500 organizations. Each one can be presented as a picture on a T.V. set.

Study forecasts $6 billion office automation market

The U.S. office automation market is growing at breakneck speed, according to a recent report by International Data Corp., Framingham, MA. Over the 1979-1985 forecast period, IDC projects a 33% average compound growth rate from $1.1 billion to $6 billion.

Variations in dollar value market shares occur as follows: word processing keyboard shipments remain level at 81% of the total through 1985; clustered word processing shipments grow from about 16% of the $891 million worth of word processing keyboards shipped in 1979, to about 41% of the $4.9 billion that will be shipped in 1985; low-end electronic typewriters remain constant, representing 10% of the market; intelligent copier/printers, not represented in 1979, will gain 6% ($360 million) by 1985; and facsimile/teleconferencing equipment will drop from 8% to 3%.

The report forecasts a gradual decline in the price for a standalone workstation and a gradual increase in per workstation costs on clustered systems, due primarily to the greater multifunctionality associated with clustered systems.

Information executives said to lack business skills

Although information executives have an ever increasing array of technical tools, they don't have sound understanding of the business issues that their bosses want addressed, asserts Herbert Halbrecht.

Halbrecht, the former president of the Society of Management Information Systems, lays the blame squarely on the shoulders of the information executives

who don't take the time to learn about business management. "The information manager doesn't understand that the user of the information (senior management) is higher up in the food chain than he is," Halbrecht said. "But he'd better learn that those who don't satisfy the business and operational needs of an organization will be eaten up.

"Too many senior information executives are still talking about the need to educate management in the use of computers," Halbrecht noted. "The shoe belongs on the other foot. More companies should follow the lead of General Electric and offer business management training."

As president of SMIS, Halbrecht conducted a series of interviews with CEOs and presidents of such companies as Inland Steel, Sperry Rand Corp., H.J. Heinz Co. and Citibank, among others. "Their single biggest complaint," according to Halbrecht, "was that technical people don't understand business."

19 word processing systems named to 1981 honor roll

Based on a recent survey by Datapro Research (Delran, NJ), 19 systems have been named to the 1981 Datapro Honor Roll. Three vendors each had more than one of their products honored; IBM with five, and NBI and Xerox with two each. Selection of the Honor Roll systems was based on the results of a mail survey of 13,300 users that brought 3,745 responses.

First place in the Standalone Systems category went to the Compucorp Omega, with the Philips Micom 2000/2001 and the Lexitron 1202/1303 taking second and third place, respectively. First place in the Multi-Terminal Systems category went to the NBI OASys 8, followed by the A.N. Dick Magna SL, and the Wang OIS 130A.

To earn a place on the honor roll, a product had to be rated by at least 15 users, earn an overall satisfaction rating of at least 3.2 on a scale of 4, and not be rated lower than 2.7 in any other category.

The rankings for standalone systems were: 1) Compucorp Omega; 2) Philips Micom 2000/2001; 3) Lexitron 1202/1303; 4) NBI 3000; 5) Adler SE2000; 6) CPT 8000/8100; 7) Lanier LTE-3 (No Problem); 8) Dictaphone Dual Display; 9) IBM OS6/450; 10) IBM Mag 2; 11) IBM Displaywriter; 12) IBM OS6/440; 13) Xerox 860; 14) DEC WS78; 15) IBM OS6/430; and 16) Xerox 850. Multi-terminal systems included: 1) NBI OASys 8; 2) A.B. Dick Magna SL; and 3) Wang OIS 130A.

GAME CORNER

by Patrick and Leah O'Connor

Copy-Cat Games

Where do you draw the line between games that are just similar and games that are direct copies? It is obvious that neither copyright law nor patent law offer any kind of protection to the computer game industry. Patent law has been interpreted to only include programs as a part of an industrial process. Copyright law appears to only protect programs from copies that are bit-by-bit identical, and even this isn't preventing "pirates" from openly and blatantly selling copies of other people's programs. Regardless of the nature of the laws covering the rights of the game designer—or "what can you get away with?"—there is a question as to the morality of copying someone else's *ideas*.

"Plagiarism," defined in terms of literature, can be litigated at a very general level. The plot of a story can be considered plagiarized at a much more abstract level than copying every word on a page. Ben Bova and Harlan Ellison wrote a story called *Brillo* some years ago. It concerned a robot policeman paired up with a human beat cop, and some of the situations they found themselves in. *Future Cop*, a television series that starred Ernest Borgnine as the human half, used substantially the same plot elements. The science-fiction writers sued the producers of the series, charging that virtually all of the *plot elements* came from their story. Bova and Ellison won. Note that the actual episodes of the program did not replicate the contents of the story published in *Analog* magazine. The case was won on the basis that the plot elements came from the story. Yet in the software domain, *exact* replication is the only criterion by which judgements of plagiarism have been decided.

Infringement suits galore?

If copyright law, as it applies to literature, were applied to computer games, every "zap the Klingons" type of game might rightly be the subject of an infringement suit by the authors of *Spacewar*, who wrote their game on a PDP-1 computer over 20 years ago.

On the other hand, if patent law were applied, any "substantial improvement" on a prior design would be treated as a "new" invention, which could itself be patented. For example, if someone invents a new design for a bottle brush, he can patent it. But if someone replaces the plastic bristles of the brush with carborundum impregnated plastic bristles, he has added a "substantial improvement" to the original bottle brush, and even though the new brush may be otherwise identical to the first, it can still be patented and sold in competition with the first brush. If patent law were applied to computer games, every minor variation might be considered a "new" game.

One of the hottest arcade games on the market today is *Packman*, manufactured by Midway Electronics. *Packman* look-alikes have already appeared for the TRS-80 and the Apple, and it should only be a matter of time before someone is selling similar games for every major microcomputer.

Scarfman, by The Consoft Group, Indianapolis, IN, is a game for the TRS-80. Even the name sounds similar, but the games are not identical. In both games, the player moves his piece around a maze and collects points for every "dot" he "eats." Both games have "monsters" that have an enabled and disabled condition—sometimes they can kill you, sometimes you can kill them. Although there are differences in the two games, the question is: are these differences really substantial?

It appears that there is a big hole in the laws designed to protect inventors. When our patent and copyright laws were drawn up, no one could have dreamed of the computers and the programs that drive them. Should computer games, and computer programs in general, be protected by law? If so, can either patent or copyright law be applied? Or do we need a new set of laws specifically designed to protect the computer industry?

It appears that we need to make a very basic decision about where similarity ends and plagiarism begins. There are levels of development in the writing of game programs. First is the storyboard level, where everything is in the form of panels that read like a cartoon strip. Next there is the flowchart level, where more of the details are worked out. Finally, there is the coding of the program into some final language. Everyone agrees that someone is stepping on your territory if his software matches yours at the code level, but what about the flowchart level? Every programmer knows that it is possible to find many ways of coding even the simplest flowchart. If someone steals a flowchart and recodes the program, have they committed plagiarism? And if a game is an obvious copy of another game at the storyboard level, is that plagiarism? We would like to hear from our readers on this subject. If you have any additional ideas, let us know.

Space game review

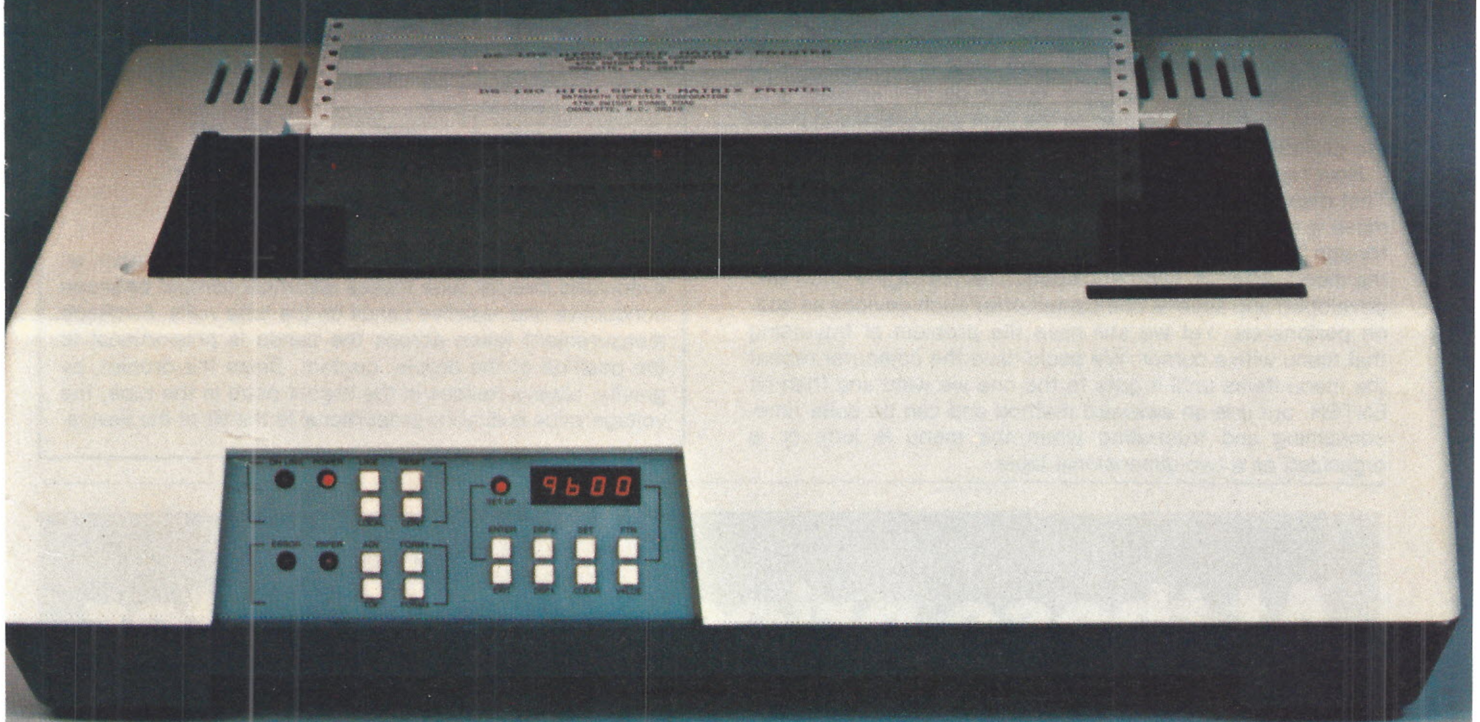
One of the advantages of writing a column is getting programs to review. This month we received several programs for the Apple computer. *Falcons* from Piccadilly Software, Summit, NJ, is another variation of space invaders that should be a big hit with arcade fanatics. As with most "shoot-um-ups," the object of the game is to destroy the enemy fleet before it destroys you. The enemy ships are in the form of flying birds (falcons) that fly above you. You attack by shooting at the falcons, and they pepper you with "droppings."

There are several different types of enemy ships that attack in various formation. As you continue, the game gets harder and harder. Ultimately, a "mother ship" complete with antenna'd alien appears. "Getting" the alien ship and pilot results in the highest scoring of the game. It also results in the highest risk, of course.

One thing missing in this game was the option of selecting different degrees of difficulty. There is only one level of difficulty, and it is definitely not for children under 12.

The demo disk we received included an option that allows the player several levels of invulnerability. Unfortunately, this option is available only in the dealer demo version of the game. Without this option, you have almost no chance of seeing the really great graphics at the advanced levels of play. It will probably take a *long* time to get proficient enough to see the endgame, even for the best space-invader player. We would recommend that the Piccadilly company considers including a selectable level of difficulty (1-5, perhaps) as a feature in future editions.

If we were to use the standard four-star system used for rating movies, *Falcons* would receive 3½ stars for its graphics and 1 star for originality—for an average of 2½ stars overall. If you are looking for a space-invaders type game for your Apple, *Falcons* (which sells for $29.95) is a good buy, but if I were buying it, I'd want to buy the store-demo version. □



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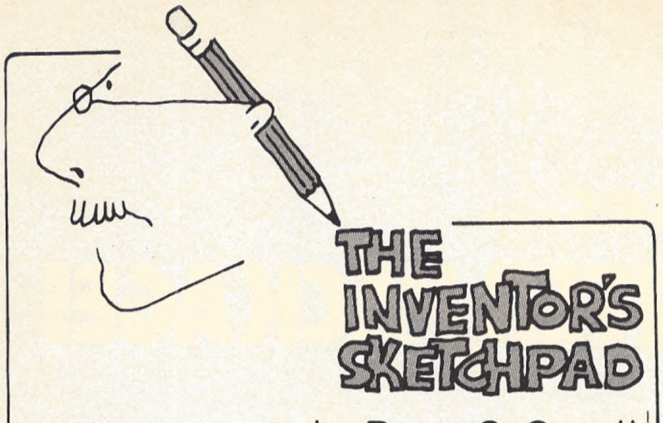

by Roger C. Garrett

A Terminal for the Blind

You are sitting in front of your computer terminal. The operating system displays a menu of options and asks you to make a selection. Using your cursor control keypad, you move the cursor up and over to the item you desire and press the ENTER button.

Now repeat that sequence, but imagine that you are blind. That displayed menu is meaningless to you. And how do you move a cursor when the very concept of cursor position is foreign to you? Perhaps the computer can speak the items in the menu. After all, synthetic speech technology is quite well developed and several companies offer such devices as add-on peripherals. Yet we still have the problem of traversing that menu with a cursor. We could have the computer repeat the menu items until it gets to the one we want and then hit ENTER, but it is an awkward method and can be quite time-consuming and frustrating when the menu is long or is organized as a two-dimensional table.

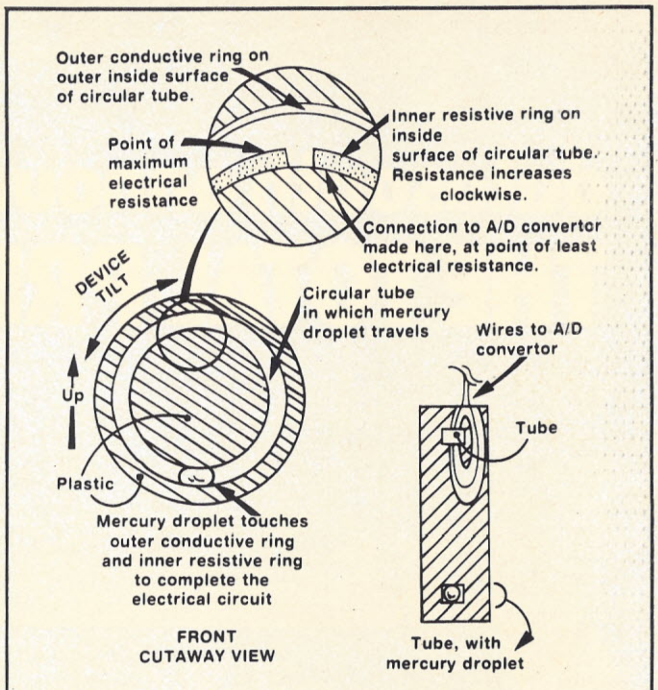

Figure 1. Inclinometer: A mercury droplet within an evacuated circular tube makes electrical contact between conductive and resistive bands on the tube walls. A voltage measurement taken across the bands is proportional to the position of the droplet contact. Since the droplet, by gravity, always resides in the lowest point in the tube, the voltage value is directly proportional to the tilt of the device.

What is it that we see visually in a display that is not conveyed by the simple audible pronounciation of the words? Extend that question even further and ask what any two-dimensional display provides that is not provided by computer-generated sounds. The answer is spatial information. The sounds generated by all of today's computers, from simple beeps, to music, to synthetic speech, are all merely a one-dimensional stream of information.

In a previous column (IA Dec 79), I described a means by which spatial information can be added to sound in order to make each individual sound (word, phrase or beep) seem to the listener to originate from a particular computer-controlled point in the three-dimensional space surrounding the user. I suggested how it might be used in game programs to add realism to the sound, making the missles seem to whiz by, and used in synthesized music to make the individual instruments seem right in the room with you.

At that time, I had not realized that it would make an ideal basis for a computer display for the blind. You might object to

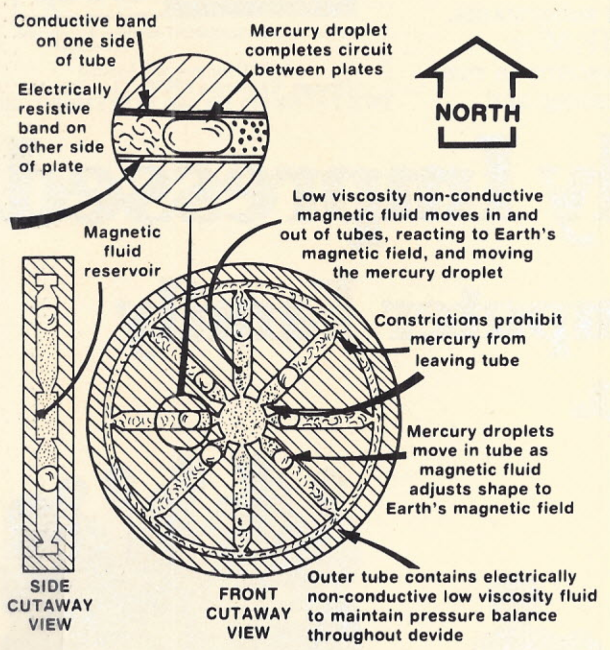

Figure 2. Magnetic fluid compass: A magnetic fluid, which "stretches" in the direction of the Earth's magnetic field, determines the positions of mercury droplets within radially oriented spokes. Each droplet makes electrical contact between conductive and resistive bands within its spoke tube. The voltage across the band is therefore a measurement of the droplet position. The set of position values is used by the computer to determine the direction of the North-South magnetic field and, hence, the rotational orientation of the device.

my use of the word display in conjunction with a device meant for the blind. But I'm going to propose that we extend the concept of display to any device that presents information that contains a spatial characteristic; that is, one that presents additional information in terms of its position in two- or three-dimensional space, whether that position be visually, audibly or tactily displayed.

In the system I am proposing, the information displayed to the user will be spoken words—words that originate from discrete positions in space, so that the user associates those positions with the words themselves, just as sighted users associate positions on the video display screen with the selections of a menu or words, sentences and paragraphs of a text stream.

The blind user is at an advantage here, however, since the audibly displayed sounds can be positioned anywhere within

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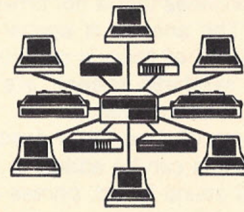

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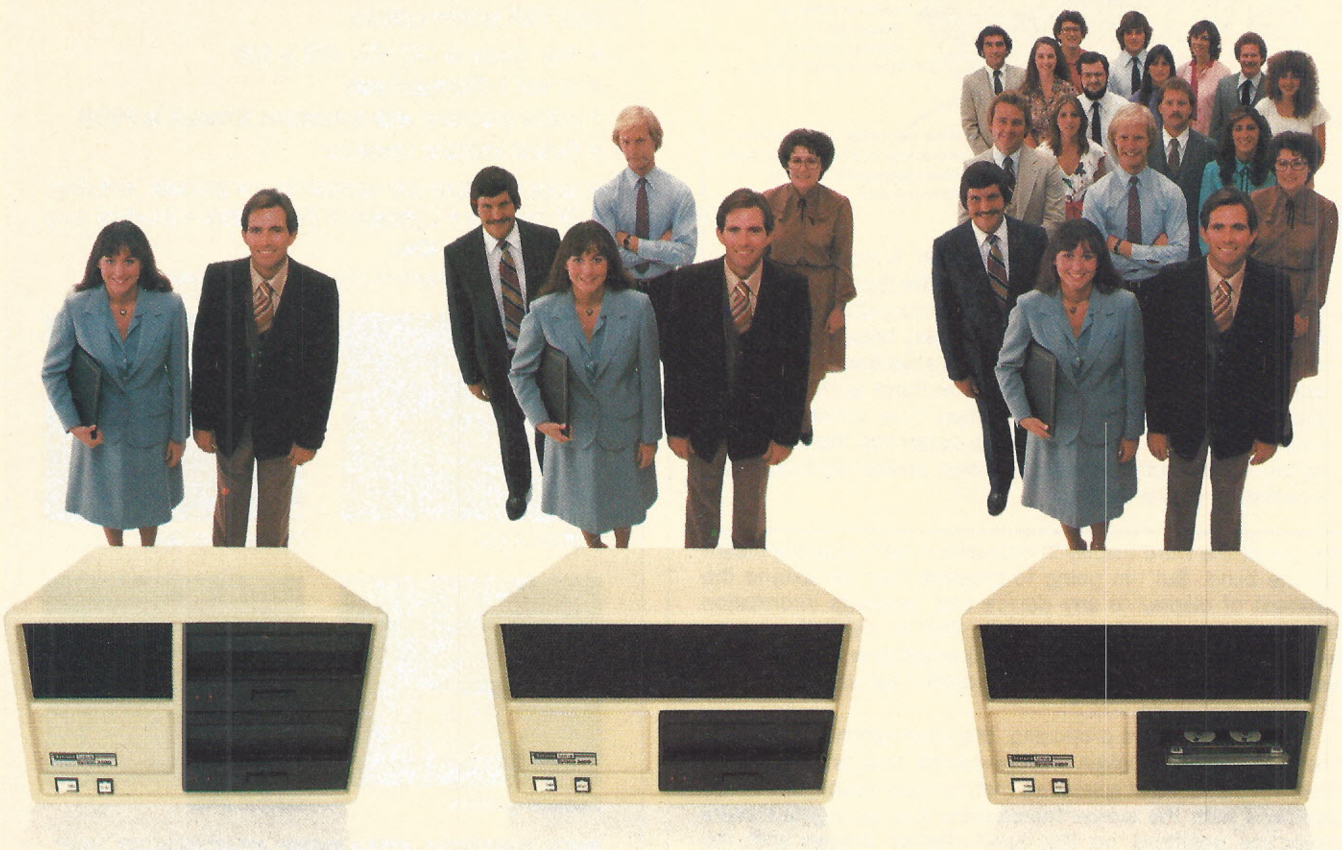

1981
Today's Requirements
Dual floppy single or multi-user system

1983
Tomorrow's Requirements
10M byte hard disk and floppy drive, single or multi-user system

1985
Your Future Requirements
40M byte hard disk and 20M byte tape back-up, single or multi-user system

CIRCLE INQUIRY NO. 53

the *volume* of space surrounding him. It is not restricted to the small two-dimensional surface of a display screen.

In my original design, I showed how spatial information is added to sounds and presented to the user via a set of stereo headphones, the spatial information being coded as volume and phrase differentials between the two speakers. A problem arises with this setup, however, because it presents information to only two ears. This means that the information is actually restricted to a two-dimensional plane, not a full three-dimensional volume.

In the real world we perceive three-dimensional sound in one of two ways. When the sound source is moving, our brain interprets the sound/phase variations and calculates the 3D positions. When the sound source is stationary, and assuming we cannot see the source, we only get 2D information. If, for example, you were in a darkened room with your eyes closed, your head perfectly still, and a cricket began chirping in the corner, you would not be able to discern its direction from you in terms of three dimensions. You could not tell whether it was on the ceiling or on the floor. Indeed, you would even have trouble telling whether it was in front of you or behind you. The key here is that your head would have to be held perfectly still.

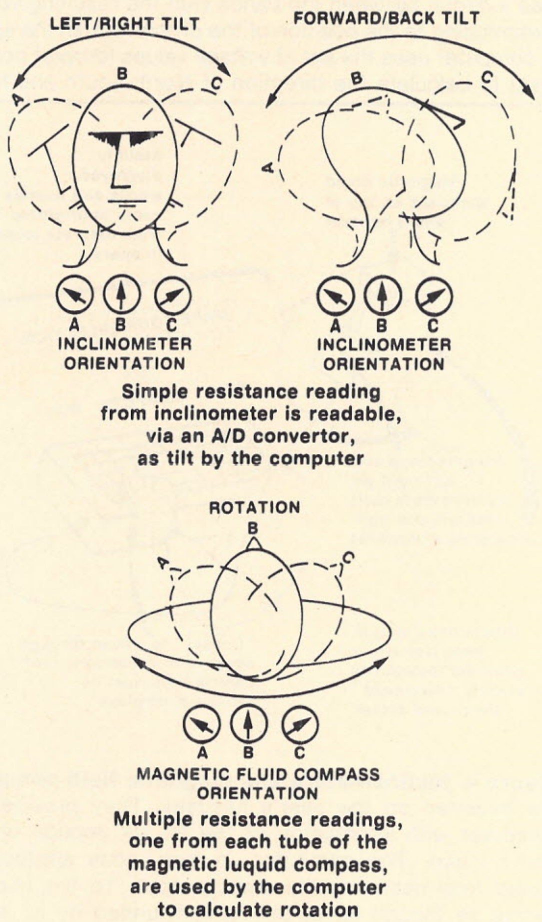

Figure 3. Two inclinometers, mounted at right angles to each other, provide forward/back and left/right head tilt measurements. A magnetic fluid compass provides rotational data.

What we do in real life, as opposed to this contrived example, is unconsciously tilt your head to get a slightly different perspective of the sound. Only then do we perceive the full spatial information. Only then can we really know the position of the sound source.

So the two ways we can use to perceive the full 3D characteristic of sound is by moving the source or moving our head. I suspect that, for our computer-generated sounds, we would not want words flying around our head, since the purpose of our system is to make it easy to point at and select those words. The answer, then, is to make it easy to use the normal head-tilting method that is second nature to us all.

If we simply use the system I described, then head tilting would have no effect, since the computer assumes a stationary user. The "display volume" would effectively move with the user's head. What the system needs is to know at all times the direction in which the user is looking, i.e. the tilt of his head, so that the spatial information added to the sound can be appropriately modified. In this way, the display volume appears to remain stationary as the user tilts his head.

The problem, of course, is getting the head tilt information to the computer. The most obvious approach might be to attach a computer-readable gyroscope to the user's head. Unfortunately, it is also the most cumbersome and expensive approach. Figures 1 and 2 show how I propose to solve the problem. Measuring the tilt of the head, both forward/back and left/right, is relatively easy, using an inclinometer. My version has a droplet of mercury that travels freely inside a circular tube. The droplet always resides in the lowest part of the tube (due to gravity) and makes electrical contact between conductive and resistive bands on the walls of the tube. As the device is rotated due to the tilt of the user's head, the relative position of the droplet changes along the resistive band, resulting in a voltage output proportional to the tilt. An A/D convertor translates the voltage into a value that can be read by the computer as a tilt measurement. One such inclinometer is mounted on each side of the user's headset, at 90° to each other, to provide forward/back and left/right tilt measurements.

Measuring head rotation is a bit more tricky, since we cannot use the effects of gravity. We can, however, use the Earth's magnetic field (providing we keep the device sufficiently far from other magnetic fields such as those generated by the earphones in the headset).

My device, in figure 2, consists of a central reservoir of magnetic liquid connected by a set of tubes arranged like the spokes of a wheel, the ends of which are connected to an outer circular tube. Within each spoke is a droplet of mercury that is moved back and forth in the spoke by the movement of the magnetic fluid. This fluid stretches out in the direction of the Earth's magnetic field, so that the mercury droplets that are farthest out from the center effectively point North-South.

As the device rotates, the magnetic fluid reacts to the changing magnetic field and the mercury droplets correspondingly change position within their respective spokes. As with the inclinometer, each spoke is lined with an individual conductive and resistive band. Each mercury droplet completes a circuit between the bands with the resulting voltage corresponding to the position of the droplet within the spoke. The computer uses the set of voltage values (droplet position values) to calculate the direction of North-South and hence the rotational position of the device. By mounting this magnetic fluid compass on the top of the user's headset, the computer can know the complete XYZ direction of the user's head.

The computer uses this information in calculating the intensity and phase differentials to apply to the individual earphones of the headset. This adds full 3D spatial information and provides a true audible display system, as flexible as any visual display. This opens up the full power of the personal computer to the blind user.

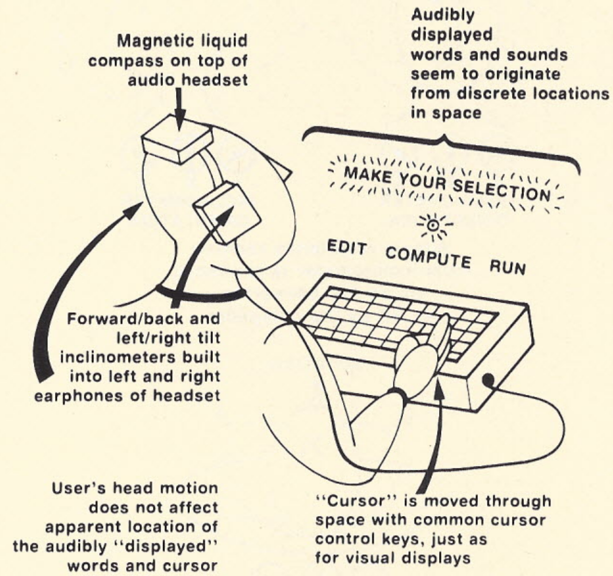

Figure 4. Inclinometers and magnetic field compass are mounted on the user's headset. They provide the computer with information of the tilt and motion of the user's head. The computer, in turn, adds appropriate spatial information to the audio output. To the user, it seems as though he or she is surrounded by an audio "display," is which sounds and spoken words originate from distinct locations in space. He can thus interact with his environment just as the sighted user interacts with a visual display. He could perceive a cursor, for example, as a beeping tone which he can move around his 3D volume using cursor control keys, as if he were controlling a bee flying around the room.

Roger C. Garrett won a Merit award for the New England region in the First Annual Personal Computing to Aid the Handicapped Contest. His entry detailed a hand-controlled voice sythensis device for the vocally impaired and was first introduced in this column (IA Mar 80). The contest was sponsored by Johns Hopkins University and was held at the Boston Museum of Science. □

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THE MICRO-MATHEMATICIAN

by Dr. John C. Nash

General Sources of Mathematical Software

One of the difficulties faced by programmers of any computer is finding suitable programs to carry out mathematical calculations. For those of us using microcomputers, the following requirements are necessary: small in memory requirement or lines of code; reliable and error-free; cheap to purchase and/or use; written in Basic of a dialect we can run or in some other language available on our machine; and machine readable. But software meeting all of these specifications is hard to find. It is worth our while to consider some potential sources of mathematical software for microcomputers and attempt to provide a guide to their utility and value.

Problem classification

If we do not have a name for the type of calculation desired, it is unlikely that a suitable program can be found. Therefore, the following general classes are useful to limit the scope of a search for a given problem type.

Numerical linear algebra. Linear algebra is the area of mathematics concerned with matrices, vectors and determinants. Since sets of linear equations (for example, five equations in five unknowns where none of the unknowns appears to other than the first power) can be written in matrix notation, solution methods for such equations fall under this heading. So do least squares problems, at least in the linear case, which accounts for about 90% of all such problems solved. Matrix inverses and eigenvalue problems, common in the study of vibrations and oscillations, are also included. Matrix arithmetic and decompositions, which are really the tools of the trade, also find their home here.

Special functions and arithmetic; approximation. As discussed in an earlier column (*Micro Mathematician*, IA Oct 81) functions used in mathematical formulae are not produced by magic from the computer electronics, but are approximated in some way by means of an easily calculated structure that needs only the four arithmetic operations + – * and /. Such a structure is a polynomial (power series) or a ratio of them (rational function). The study and development of approximations and their implementation in good codes for computers in a very particular area of numerical mathematics. Recommendations are difficult, because approximations that work well on one hardware systems are totally unsuited to others. Finding appropriate programs is hard for practitioners; novices should beware. This area also encompasses complex arithmetic, special extended precision and similar topics.

Differential equations and quadrature. The numerical solution of differential equations is a large area with many subspecialties. Usually the solution cannot be written as an integral with definite limits, but when it can or when such a definite integral must be evaluated, one needs a good quadrature program. Ordinary differential equations, where derivatives are taken with respect to only one variable, are frequently categorized by their stiffness. This refers to problems where the equations describe several processes that differ greatly in speed (for example, a chemical reaction in which certain parts happen quickly over a few picoseconds while other steps take seconds to occur).

Partial different equations involve derivatives with respect to several variables simultaneously. Some problems can be decomposed to sets of ordinary differential equations and may be easier to solve in that way. Others—weather prediction by hydrodynamic modes for example—require methods suited to the problem. Frequently these methods are very particular to the problem.

Fourier methods. It is worthwhile separating our methods for solution of differential or difference equations via fourier series (or similar approaches) since there are so many different techniques and algorithms used. In recent years the development and use of the Discrete Fourier Transform (DFT) or Fast Fourier Transform (FFT) in the analysis of signals in applications such as Radar, Sonar or Computed Tomography has become a science in itself. Because of the military and commercial value of these techniques, it is often hard to obtain good programs from public sources.

Simulation and random number generation. In games, system simulations, statistics and operations research, one needs to be able to generate sequences of numbers drawn at random from various distributions. The study of such methods and their effective use avoiding unnecessary computation is a field of research involving a number of mathematicians and computer scientists. Another name associated with this area is the Monte Carlo method.

Optimization. The study of the selection of parameters to minimize or maximize a function is optimization. Constraints may or may not be imposed on the parameters (constrained optimization); when there are a great many constraints the problem may be referred to as mathematical programming, a nomenclature that causes some confusion with computer programming. Root-finding is a related problem in which one wishes to find the parameters that make a function zero.

Symbolic manipulation. It is possible to make the computer do our algebra for us by clever programming. Using techniques of artificial intelligence, a number of systems for symbolic algebraic manipulation has been developed, including one for microcomputers (MuMath). This area is very different in its practice from the rest, but is truly a part of mathematical software.

Types of software sources

In which ways may a working program be implemented on a given computer?

Purchase. One may buy a program configured for the machine in question that performs the desired task. This option has, to date, been a rare possibility for microcomputer users. Even rarer has been the case where the program is available in suitable machine-readable form.

Conversion. A program may exist in a similar dialect of a programming language available on the target machine or in a language that we can understand and translate easily. With mathematical software, of course, there are frequent questions of precision, tolerances and other machine dependencies.

Implementation from algorithm. Here we take the numerical analysis or other book and proceed to prepare a program that will carry out the steps of a desired algorithm.

Mathematical software vendors

Because the market for mathematical software is both sparse and fragmented, there are correspondingly fewer vendors of suitable software. Whereas on large machines quality libraries and subroutines are obtainable, no similar collections exist for micros. A group of math software specialists is developing a collection for micros under the collective name C.Abaci (Raleigh, NC). While some topics are

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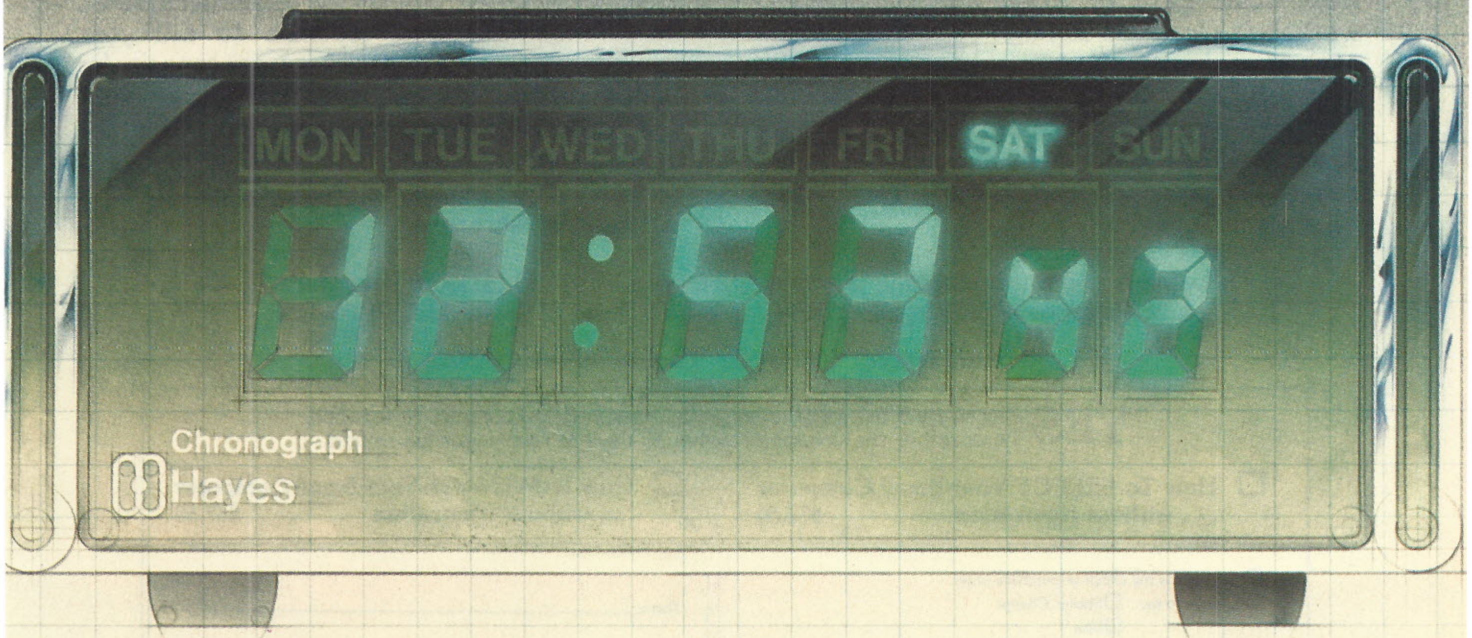

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currently offered, notably linear algebra and special functions on some target machines (e.g. Radio Shack model II), it will be some time before a comprehensive collection is available.

The Association for Computing Machinery (ACM) has published and distributed algorithms coded in various computer languages (mostly Fortran and Algol) since the early 1960s. Originally published in the Communications of the ACM, they now appear in the ACM Transactions on Mathematical Software (TOMS), with the Collected Algorithms being distributed on 0.5-in. magnetic tape, cards or listings by IMSL. Unfortunately, few programs are in Basic, many are quite large and many early programs were untested.

. . . The last resort in conversion is to implement a method given in a published article . . .

A product that deserves mention is David Stoutmeyer's MuMath. I am highly impressed by its performance in demonstrations.

A final offering worthy of inclusion is the recently published book by F.R. Ruckdeschel, *Basic Scientific Subroutines, Volume 1*, Byte/McGraw-Hill, Peterborough, NH. This is designed for the microcomputer user, with listings in North Star and Microsoft Basic. Furthermore, the programs fit together to form a coherent set. All the subroutines are designed so there is no need to alter variable names and line numbers. The first volume treats plotting, complex arithmetic, linear algebra, random number generation and series approximation. Other topics, such as least squares, optimization and integration will appear in Volume 2 shortly. While I am very impressed with the excellent attention to the programming and user needs, the algorithms used leave a lot to be desired. The absence of up-to-date techniques is troublesome for serious application needs. In particular, the lack of modern eigenvalue programs will inhibit many users from taking advantage of the software.

When the program wanted is not available in a form suitable for our machine but a version exists in another dialect of language, conversion is possible. I am sure few microcomputer users needing scientific programs have not had the experience of translating Fortran. The main problems that arise are program size exceeding memory (either code length or working storage); lack of double precision for accumulation (more generally an awkwardness in adapting the data types REAL, DOUBLE PRECISION and INTEGER to the single level of precision in Basic); changes in variable names to suit the Basic interpreter or compiler; lack of true subroutine construct in Basic with attendant difficulties in converting segmented programs into a single set of code; and lack of adequate explanation of the Fortran code so programming style can be altered to take advantage of facilities in Basic, such as character handling.

Sources such as the Collected Algorithms of the ACM are useful in conversion exercises. Libraries such as NAG and IMSL do not make source code generally available, though their collections would be obvious starting points for reliable methods. Older collections may contain obsolete or faulty programs, the conversion of which jeopardizes the correctness of applications.

Given the dangers and difficulties of conversion, it is my practice to avoid it for all but the most obvious candidate programs. My conditions are that the task be well-defined and limited in scope, so that I can readily see the impact of any changes in names, structure or precision. Otherwise, my choice is to implement from a description of the algorithm directly in order to avoid the introduction of programming language artifacts or copy the errors made by others in their implementations of methods.

Implementation from algorithms

The last resort is to implement a method from a written description given in a book or journal article. Here the user may be the pioneer who must correct the errors of others—the written description of the algorithm may in no way correspond to the actual programs used by the author. Nevertheless, some efforts have been made in a number of works to specify the required steps in numerical methods and to include details that may be crucial for their correct operation. In my own book (*Compact Numerical Methods for Computers: Linear Algebra and Function Minimization,* Halsted Press, NY), I use a simple step-and-description method for presenting the algorithms. In most cases, users have been able to implement faster from this form of presentation than by translating between dialects of Basic or Fortran. Of course, the range of subjects is limited in scope and will not satisfy all needs.

Finding a suitable source of methods, then choosing the appropriate one is not easy. As a general handbook for numerical methods, I recommend the book by G. Dahlquist and A. Bjorck, *Numerical Methods*, Prentice-Hall, Englewood Cliffs, NJ. I also use the Collected Algorithms of the ACM as a source of references to the method as well as a potential program in some or other language. This is a help in avoiding some of the weaker algorithms that appeared in early years of publication. □

Learning with Micros

by Louis E. Frenzel

Software Portability in Microcomputers

Wouldn't it be nice if the CAI program you just wrote for your TRS-80 would also run on an Apple? And a Pet/CBM, and a 99/4 and a Z89? While the program will meet your needs, you might also help others if that program were transportable to other micros. But as it is, your program will only run on machines like the one you developed it on. You will get value from the program, but if it were fully transportable, others could benefit from it, and you may even profit if a software house publishes it.

Unfortunately, microcomputer programs are simply not transportable. There are just too many different CPUs, languages and configurations. We keep hearing that the lack of software is holding back the more widespread use of micros in education and other fields. But, as more software is becoming available, another problem—lack of transportability—may be a major setback.

In the microcomputer field, there is virtually no direct software portability. That is, a piece of software written for one microcomputer will almost never run on another type of microcomputer. In fact, there is even software incompatibility within machines of the same type. Changes in the Apple Disk Operating System from version 3.2 to version 3.3 are a good example. Software transportability does not generally exist among different brands of microcomputers. Software written for an Apple II will not run on a TRS-80. Even software written for similar hardware configurations may not work. For example, a program written for one Z80/S100 bus (IEEE696) CP/M/ MicroSoft Basic machine may not run on another.

The lack of portability results from one or more of the following factors:

1) language differences (i.e. MicroSoft Basic vs. North Star Basic)
2) different operating systems (TRS DOS vs. CP/M)
3) operating system differences (i.e. CP/M version 2.2 vs. CP/M version 1.4)
4) I/O differences (i.e. port address assignments)
5) peripheral differences
6) mass storage format differences (i.e. cassette vs. disk; disk format differences such as hard vs. soft sectoring; track, sector and bytes per sector variances)
7) CPU incompatibility (Z80 vs. 6502)
8) terminal/CRT variations (25 x 80, 16 x 64, 25/40)
9) graphics differences (color vs. monochrome, pixel resolution, special characters)
10) memory allocation incompatibility (RAM map variations, stack location, RAM size)
11) CPU clock frequency

Although there is little direct portability, there is the possibility of some transferability. For example, machine code that is written for a particular microprocessor (CPU) will run on any micro using that CPU, assuming that differences in RAM size/ map, operating system, I/O port assignments, clock speed, etc. are resolved. Also, programs written in a higher-level language for one machine will theoretically run on another machine using that same language. For example, software written in MicroSoft Basic for the Apple II should run on a Zenith Z89 using Heath Basic, assuming that variations resulting from statement/command differences, incompatible graphics formats, different operating systems and different disk formats are adjusted.

Resolving the differences or making the appropriate adjustments are often difficult. In fact, many programmers say that it is sometimes faster and easier to rewrite a program from scratch than it is to fix it.

With over one million microcomputers on the market and many more on the way, it would seem desirable to make software more transportable. Software authors and their publishers would especially love to see this—as would the users. So what can be done about it?

First, total compatibility can only come with complete standardization of CPUs, languages, I/O and mass storage formats. This has been dreamed of, discussed, recommended, and cursed for large mainframes and minis for decades. It has never been achieved, and it is not likely to be accomplished with micros either. Manufacturers will never agree on one CPU, operating system or anything else. In fact, many manufacturers use their unique software products as a selling tool. The idea is that if the manufacturer has a highly desirable program, it will help sell his hardware. This certainly limits distribution of the software, but it does indeed help sell machines. You can expect this practice to continue.

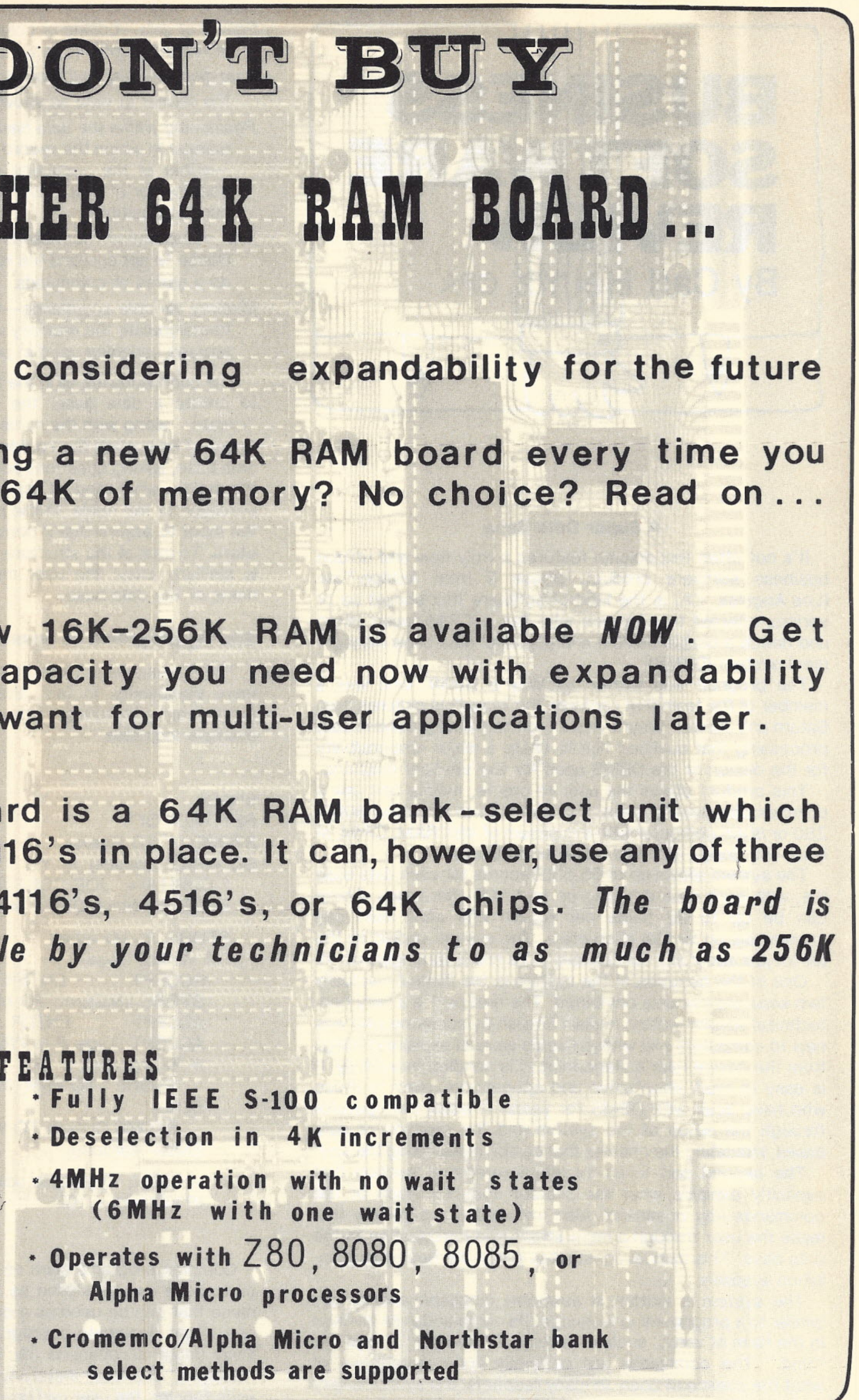
Call for standardized language

Standardization is a myth and a dream at the CPU level, so do not expect to see it. But here is hope that transportability will improve at the language level. Right now, since most major micros use MicroSoft Basic and since most Basics are similar, a program written in Basic does offer at least some portability. You may have to patch a few places and re-keyboard it, but usually you can move the program from one machine to another. But it is not easy. The biggest drawbacks usually involve graphics—just the thing most educators need. Big differences simply cannot be adequately resolved.

Going to a language like Pascal may help further. Assuming a "standard" Pascal, a program written for one machine can be moved to another if the machines in question have an appropriate interpreter for the intermediate P-code that the Pascal compiler generates. The problem is to agree on one Pascal. At least this is a step in the right direction.

The issue of portability may never be adequately solved. But as some language standards are developed and as new languages appear on the scene, we will get closer to the dream of universal software portability.

In the meantime, if you want maximum portability, stick to standard languages, (Basic, Pascal, etc.) and use only the commands, statements, etc. that are common to all versions of the language. That sub-set is pretty easy to determine. Also, be aware of the differences between the machines you want to use the software on. If you, for example, want that CAI program to run on Apple, Atari, Radio Shack and TI machines, be sure you know the differences in graphics so you can easily change them for each machine. Or avoid them altogether if you can. Maximum portability usually compromises the end product in some way. But the result—greater software availability—may be worth it. □



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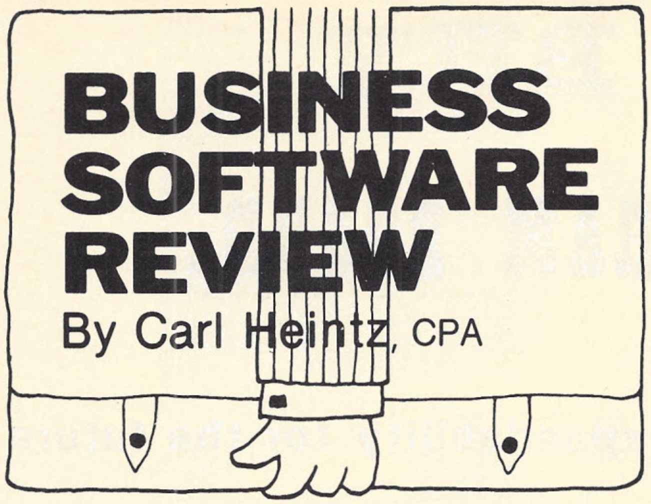


A Super Data Base

It's not often this column features a truly new and unique business software product. Dbase II from Ashton-Tate (Los Angeles, CA) is the kind of software that should be of serious interest to everyone who has a CP/M-based micro and needs a usable flexible and powerful data base management system (DBMS).

The program was written by Wayne Ratliff, who was a member of the team that captured the incredible pictures from Saturn and Jupiter. Wayne has a technical background in data processing that qualified him to share a major responsibility for the design of the DBMS used for the Voyager missions.

This product allows the user to create, modify and use a complex data base system. It is designed to run on an 8080, Z80 or 8085 computer with a minimum of 48K RAM, CP/M, at least one floppy disk and a printer if desired.

The system allows up to 65,535 records for each data base file, with each record having up to 1,000 characters. There can be up to 32 fields per record and each field can encompass up to 254 characters. The system should fill the bill for just about any conceivable word processing application.

One of the beauties of the system is the manual—actually two separate manuals combined. The first part is a very non-technical version written in plain English by someone who was new to computers and whose talents were in explaining things from the novice user's standpoint. It is handled beautifully. It is easy to read, informative and educational, even to those who have dealt with DBMS for years. It leads the operator through the setup of the system and the creation of data bases, indicating the choices that can be made along the way.

The second part is an excellent reference section that explicitly explains what the system does for each of the commands—by command. Also included is a summary that leads the user through a more structured introduction to the data base. This manual constitutes about the best documentation available.

The system is written in assembly language and is very similar to a programming language. Its commands are invoked in the form of verbs, such as "create," "change," "read" or "find." The commands are generally quite descriptive of what the command does. In many respects, the syntax is very similar to that of Condor, which is a comparable product.

There are several classes of commands, including the following:

Creation of files—Creating, copying existing files, creating a report form file, creating index files, joining two data bases, etc.

Addition of data—Appending data to the end of a file, insertion of data into an existing file, etc.

Editing of data—Editing of columns or fields, making deletions of records, updating a data base on a batch approach

Data display—Displaying of records, fields or expressions, or the format of data as shown in the files

Positioning within the data base—Commands that control the manner in which the record pointer is positioned in the file—either at the beginning of the file, at some specified position, or at a position forward or backwards from the current position

File manipulation commands—File commands that allow Dbase to append one file to another, select, sort, copy or do a series of commands

Memory variable commands—Commands that allow the user to manipulate the memory variables, such as the transient storage variables used in processing programs

The commands are all in the format of verbs. In other words, to create a data base, the user specifies the command "create," along with the name of the data base he wishes to create. The system then guides you through the creation of a data base, asking questions such as the names and lengths of the fields, what kind of data they are to contain and the precision of the fields. In the process, the program monitors the input to assure that it corresponds with allowable parameters. To look at the structure of a data base already created is similarly easy; the user merely specifies "display" and name of the data base.

Storing programs as command files

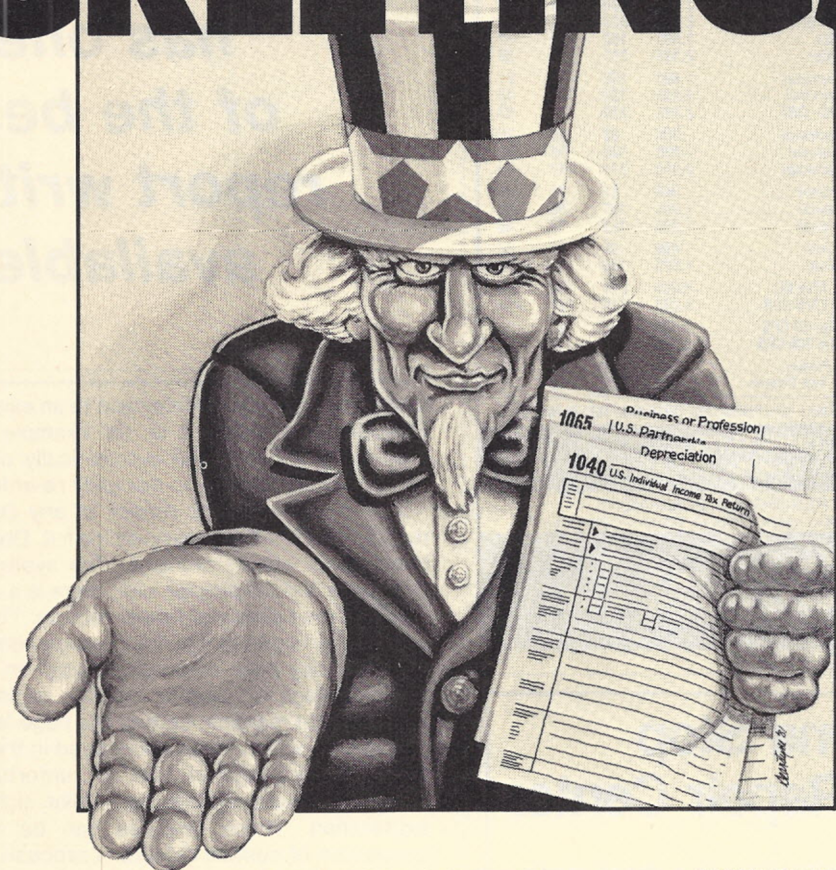
The commands in Dbase II can also be linked together for more complexity. In fact, they can be used almost like a programming language, as the accompanying program example indicates.

```
ERASE
SET TALK OFF
STORE 'Y' TO Bases
DO WHILE !(Bases) = 'Y'
   ? CHR(14) + ' JOB COST SUMMARIES ' + CHR(15)
   ACCEPT 'Which DRIVE and DATABASE?' TO Database

   STORE 'Y' TO Again
   DO WHILE !(Again) = 'Y'
      ACCEPT '        ENTER CLIENT CODE' TO MClient
      STORE !(MClient) TO MClient
      ACCEPT '        ENTER JOB NUMBER' TO MJob:Nmbr
      ACCEPT 'Type P to PRINT the report' TO Hardcopy
      IF !(Hardcopy) = 'P'
         STORE ' TO Print' TO Hardcopy
      ELSE
         STORE CHR(0) TO Hardcopy
      ENDIF Hardcopy

      ACCEPT 'Type C to add CONDITIONS' TO Other
      IF !(Other) = 'C'
```

Complex programs such as the one that is reproduced in part above can be stored as "command files," and given a name that can be used as a command itself. In other words, one might designate a program as "checks," and store it away under a command file. When it is appropriate to run "checks," the user merely types "do checks." To make it even fancier, the user can have a program that places a menu on the screen (the manual explains exactly how to do this) and upon the choice of one of the alternatives, the program itself automatically goes to the previously written program.

Essentially, Dbase II can replace a Basic language program. A system developer could easily develop a very professional program without ever leaving Dbase. Additionally, a program developed this way has the advantage of being easily modifiable: reports can be added at the terminal, and data base

SEASONS GREETINGS.



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F, SE	•	•	•
K, K-1			•
2106	•	•	
2119	•	•	
2210		•	
2440	•	•	
2441	•	•	
3468		•	•
3903	•	•	
4137	•	•	
4562	•*	•	•
4625	•	•	•
4684	•	•	•
4726	•	•	
4797		•	•
4952			•
4972		•	
5695	•	•	
6251	•	•	
6252	•	•	•
6765		•	
Accelerated Cost Recovery System		•	•
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IRS-approved forms	•	•	•
On IRS forms		•	•
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operating performed without resorting to additional programming, as would be the case of a program developed in Basic.

There are a number of additional features that allow a user to read files created by other data bases or applications languages, and to write to those files. In other words, this

The system has one of the best report writers available.

system can be used to interface to an existing Basic program. Consider how useful it is, for example, to be able to tap existing data bases and automatically convert them to this format without having to manually re-enter all of the data.

The most important aspect of any DBMS is the kind of reports that can be generated from it. Dbase II has one of the best report writers available. The system is designed from two levels. On the simpler side, there is a command that allows one to format simple columnar reports. The system assists the user and prompts him in the development of a simple report. Columns may have subtotals in addition to totals, and there are provisions for double spacing, pagination, changing the left and right margins, setting the page length, etc. The user can specify which items are desired in the report, and in what order they are desired. Left out, unfortunately, are routines to put in double underlining, dollar signs, and any text or explanation. These features can be added through the generation of custom reports, a process that constitutes the second option for the user of the data base. Using this option, the user can specify exactly what data is to be placed where. For example, in addition to generating a custom report, the system can be used to print on invoice forms, on checks, or can be used to generate custom forms.

Documentation and input sequence

The programs include a simple editor program, which is used on the screen to set up exactly what will print and how. The manual is very clear on how to use it, and the system is much easier to use than other comparable report formatters. But the best part about the report formatter is that the documentation is oriented towards the novice user, and gives some excellent tips on how to approach the task. The excellent books by Osborne (Berkeley, CA) on accounting systems are recommended as an example of how to set up CRT masks and report formats.

The input sequence for the data base system is equally impressive. In addition to a very simple format in which input is invoked by the APPEND command, there are some very sophisticated features.

In the simple input sequence, the user is given a record number by the system, then all field names are presented with a field length for each one shown by colons. The user merely fills in the blanks. To get more complex, the user can construct a custom CRT mask that will enable a totally flexible input sequence. In other words, the user can set up any order of entry of data, and can have additional explanatory matter on the CRT, plus use names that are more complete than the

field names in the data base to prompt users. This custom input sequence is made easy to use because the instructions in the manual are oriented to the novice user. They are complete, presented in a step-by-step fashion.

The data base system has a very complete array of commands. There are many commands that allow the user to modify the data. For example, an edit command may be invoked to either change or replace data within the data base. These commands allow a batch change of data within a data base, for example, in the case of posting journal entries to the general ledger.

The system has the capability of working with more than one data base at the same time. This is done by partitioning the user space into two separate areas, designated as primary and secondary. In each area, the user can have a data base open and be actively processing data. It's something like the MP/M user 1 and user 2. The difference is that data can be exchanged across the line. This allows for very rapid exchange of data. It is useful, for example, in the case where one data base updates another, with both data bases remaining intact at the end of the operation. (The system also includes commands that allow one data base to be appended to another, and also allows two data bases to be joined to form a third data base.) In addition to just dealing with data bases, the system can set up working files to be used to deal with multiple data bases, and may read from and write to files created by other applications programs (such as those created by Basic or Fortran or even Pascal).

The system has all the expected file manipulation commands for finding items within a data base. A user can find records by their record number, by a conditional match (for example all files that match the condition of being for $50 or more, but less than $120, and written on 1/15/82). Additionally, the system can skip from file to file by multiples, or scan one by one. Even more impressive is the ability of the user to specify exactly how files are to be organized. The user can organize a data base using either sequential or indexed files. This adds a tremendous amount of flexibility. Using sequential files often makes sense in the case of transaction registers that are then posted to other files. Using indexed files is the best for files that may require access on a number of different keys. Multiple indexes can be created and the indexes are always updated automatically by the system. Further, the system has the ability to locate an item in a very rapid fashion, since a modified B-tree algorithm is used. In even a very large data base, the access time is generally always within two seconds or so. With a hard disk, the times are considerably faster.

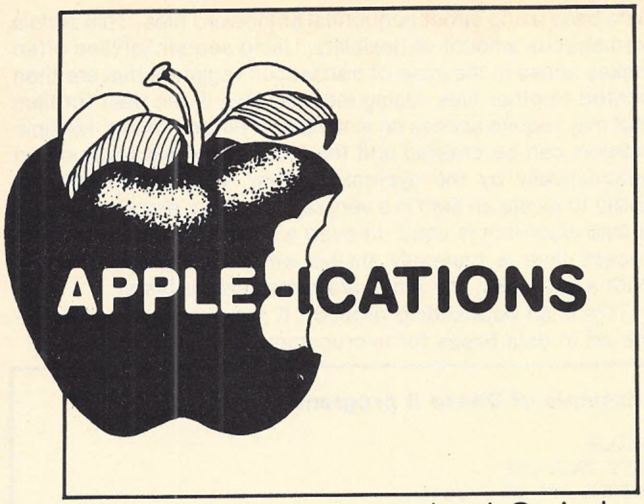
This is an outstanding product. It represents the state-of-the-art in data bases for microcomputers. □

Example of DBase II program

```
ERASE
SET TALK OFF
STORE 'Y' TO Bases
DO WHILE !(Bases) = 'Y'
  ? CHR(14)+'    JOB COST SUMMARIES     '+CHR(15)
  ACCEPT 'Which DRIVE and DATABASE?' TO Database

  STORE 'Y' TO Again
  DO WHILE !(Again) = 'Y'
     ACCEPT '          ENTER CLIENT CODE' TO MClient
     STORE !(MClient) TO MClient
     ACCEPT '           ENTER JOB NUMBER' TO MJob:Nmbr
     ACCEPT 'Type P to PRINT the report' TO Hardcopy
     IF !(Hardcopy) = 'P'
        STORE ' TO Print' TO Hardcopy
     ELSE
        STORE CHR(0) TO Hardcopy
     ENDIF Hardcopy

     ACCEPT 'Type C to add CONDITIONS' TO Other
     IF !(Other) = 'C'
```



by Robert Swirsky

User Proofing Apple's DOS

No matter how carefully a program is written to handle unexpected input, there is always one user who manages to get the program to bomb and return to the operating system. Sometimes the bad input is unintentional, like when a person types in a letter when the computer wants a number. At other times, the user may intentionally try to get the program to crash. This often happens in a classroom where it becomes a challenge to break into the operating system and screw up all the disk files, delete programs and other "fun" things.

Making the program immune to bad input comes with careful programming techniques. However, doing the same with the operating system requires some programming tricks. In many cases, it is desirable to eliminate certain DOS commands, such as DELETE or INIT, and modify others so that only certain users have access to them.

With only a few minor changes, it is possible to modify the DOS on an Apple II computer to keep unwanted users from tampering with it. After the changes are made, the modified DOS is either initialized on a new diskette, or placed on one using either the Update or Master Create programs.

Changing the DOS commands is easy. Using listing 1, locate the DOS command you want changed. The first column lists the memory location, the middle column contains the ASCII character and the third column contains the contents of the byte in decimal. (The program that generates the chart is in listing 2.) Suppose you want to change the command CATALOG. Looking at listing 1, the locations for the command are found between 43218 and 43224, inclusive. To change it to DATALOG, simply poke 68 (ASCII "D") into location 43218. Now when CATALOG is typed, the ?SYNTAX ERROR message will be generated. But if DATALOG is typed in, the usual disk catalog will be shown. Using the same method, any disk command can be changed to anything else, as long as the revised version contains the same amount of characters. Even control characters can be used, with the exception of the LF, CR and CTRL-X. Just remember that a control character and a printing character will both fill up one byte, even though the control character doesn't print out.

The advantage to changing the DOS commands around is that only people who know the revised spellings can use them. If the DELETE command is changed to GNURPH, a person who tries to DELETE a program will obviously be unsuccessful. However, *you* can remove a file by GNURPHing it.

In order to save the modified DOS commands so they will be present whenever the DOS is booted, take a blank disk and initialize it after the changes have been POKED into memory. The DOS on the newly initialized disk will contain your changes.

The program shown in listing 3 has a rather interesting effect. After this program is run, *only* DOS commands can be executed. Applesoft commands given in the direct mode will cause the computer to hang. Program runs are not affected, with the exception of files that are EXECed. By using this, a person is prevented from using LIST, NEW, DEL or any other direct command. To run a program after listing 3 is run, it is necessary to use the DOS command RUN <FILENAME>. RUN on it its own will not work.

This program works by disconnecting the DOS from Applesoft. When a direct command is issued, it will check to see if it is valid under DOS. If not, it will cause the computer to hang instead of passing the command to Applesoft. In cases where you don't want your programs listed or modified by unauthorized users, the program works nicely.

Just like the DOS command changes, this program can be added to the DOS and be in the computer every time the disk is booted. This is done as follows:

1) Write a short "hello" program and save it.
2) Type in the program in listing 2 and run it.
3) LOAD your HELLO program.
4) Insert a blank disk and type "INIT <NAME>"
5) Copy the programs you want on the new disk using the LOAD <NAME> and SAVE <NAME> commands.

Now whenever the disk is booted, the values from the POKE commands in listing 3 will be in memory. Only DOS commands will work from immediate mode. This program can also be combined with any DOS command spelling changes made.

These routines have been tested on a 48K Apple II Plus, under DOS 3.3. If you are using an older DOS, they may not work, as the locations of the various DOS routines have been moved. With less than 48K of memory, the POKE locations will have to be moved down, the exact amount depending on memory size.

The next time someone tries to fiddle with your files, you'll be prepared. These programming "tricks" have been extremely helpful in situations where unauthorized use of certain commands needed to be stopped.□

Listing 1

```
]RUN
43140     I     73
43141     N     78
43142     I     73
43143     T     212
43144     L     76
43145     O     79
43146     A     65
43147     D     196
43148     S     83
43149     A     65
43150     V     86
43151     E     197
43152     R     82
43153     U     85
43154     N     206
43155     C     67
43156     H     72
43157     A     65
43158     I     73
43159     N     206
43160     D     68
43161     E     69
43162     L     76
43163     E     69
43164     T     84
43165     E     197
43166     L     76
43167     O     79
43168     C     67
43169     K     203
```

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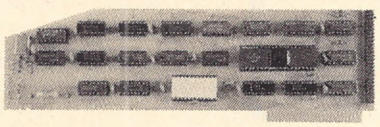

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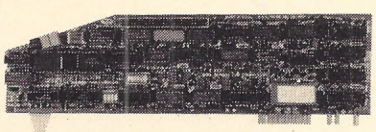

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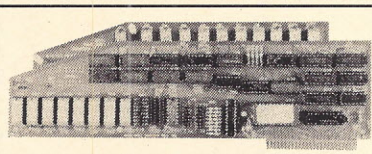

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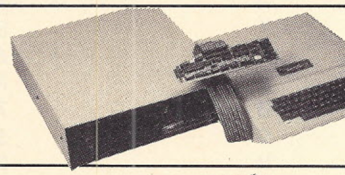

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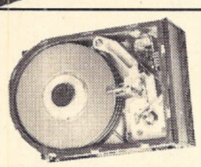

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43170	U	85
43171	N	78
43172	L	76
43173	O	79
43174	C	67
43175	K	203
43176	C	67
43177	L	76
43178	O	79
43179	S	83
43180	E	197
43181	R	82
43182	E	69
43183	A	65
43184	D	196
43185	E	69
43186	X	88
43187	E	69
43188	C	195
43189	W	87
43190	R	82
43191	I	73
43192	T	84
43193	E	197
43194	P	80
43195	O	79
43196	S	83
43197	I	73
43198	T	84
43199	I	73
43200	O	79
43201	N	206
43202	O	79
43203	P	80
43204	E	69
43205	N	206
43206	A	65
43207	P	80
43208	P	80
43209	E	69
43210	N	78
43211	D	196
43212	R	82
43213	E	69
43214	N	78
43215	A	65
43216	M	77
43217	E	197
43218	C	67
43219	A	65
43220	T	84
43221	A	65
43222	L	76
43223	O	79
43224	G	199
43225	M	77
43226	O	79
43227	N	206
43228	N	78
43229	O	79
43230	M	77
43231	O	79
43232	N	206
43233	P	80
43234	R	82
43235	#	163
43236	I	73
43237	N	78
43238	#	163

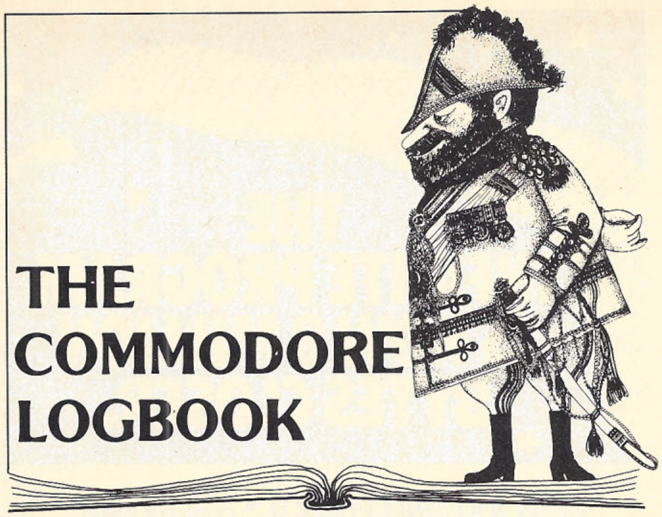

```
43239     M     77
43240     A     65
43241     X     88
43242     F     70
43243     I     73
43244     L     76
43245     E     69
43246     S     211
43247     F     70
43248     P     208
43249     I     73
43250     N     78
43251     T     212
43252     B     66
43253     S     83
43254     A     65
43255     V     86
43256     E     197
43257     B     66
43258     L     76
43259     O     79
43260     A     65
43261     D     196
43262     B     66
43263     R     82
43264     U     85
43265     N     206
43266     V     86
43267     E     69
43268     R     82
43269     I     73
43270     F     70
43271     Y     217
43272           0
43273     !     33
```

Listing 2

```
10   FOR X = 43140 TO 43273
20   PRINT X, CHR$ ( PEEK (X)),
     PEEK (X)
30   NEXT
```

Listing 3

```
1   REM :THIS PROGRAM PREVENTS ANY
2   REM :NON-DOS COMMAND FROM
3   REM :BEING EXECUTED IN THE
4   REM :DIRECT MODE.
5 :
6   REM :PROGRAM WRITTEN BY:
7   REM  ROBERT A. SWIRSKY
8   REM  ----------------------
10  POKE 40960,234
20  POKE 40961,234
30  POKE 40962,234
40  POKE 40963,234
```



THE COMMODORE LOGBOOK

by Mike Heck

Mupets to the Rescue

Microcomputers are much more limited than their mainframe counterparts—in terms of speed, memory size and the number of devices that can be attached to them. Where micros have an advantage is in smaller applications where their power and performance are quite acceptable. However, in the intermediate area, where many microcomputers must be used in order to get acceptable results, but where the larger system would still be too much power, micros are not cost effective. In order to get the desired performance, you must configure many dedicated microcomputers, each with its own disk and printer. This type of setup erodes many of the savings that microcomputers can offer because disks and printers are typically the most costly components of the system.

And in this "cluster" microcomputer configuration, the peripherals might be used only a small fraction of the time. For example, in a word processing situation, most of the time is spent entering or editing text, rather than printing documents or using the disk for storage or retrieval.

The ideal case would be to utilize the peripherals more effectively by having a number of computers share the same resources. Each user would have a dedicated CPU, while they share the more expensive peripherals: disks and printers. With this simple concept of shared resources, the overall system is a very cost-effective microcomputer solution to many medium-scale computing needs.

Of course, there is a catch. It is very simple to attach a number of Commodore Pet or CBM systems to any peripheral. Just "piggyback" the IEEE-488 connector from each computer to the disk or printer, or both. The problem arises when one computer wants to access the device at the same time another CPU needs it. The resulting conflict will cause some unpredictable conditions, at best; data may be lost or diskettes corrupted.

The solution is to design a device that will monitor the overall network of CPUs and assign priority to the requests for peripheral access. In this way, if an input/output (I/O) operation is occurring, all other systems will be given a "busy" message and locked out until the first system is finished with its task. Such a device is Mupet for use with Pet/CBM systems (King of Prussia, PA). The unit is developed by BMB Compuscience, Ltd., Ontario, Canada, distributed by Canadian Micro Distributors in Milton.

The heart of the device is a controller that performs the manager function. In addition, there is a small interface that plugs into the IEEE-488 connector of each computer, and a ribbon cable that chains all the computers together. On the last interface, a terminator plug is used to complete the loop. All peripherals are connected via the IEEE-488 connector on the control box.

It will work with up to eight computers. The only limitation is the length of cables between systems: BMB recommends total cable length of no more than 60 feet per system.

Once all the computers in the system are tied together through the interfaces, the free end of the cable from the CPUs is connected to the controller. Then the peripheral is attached to the IEEE-488 connector on the controller. Nothing else is necessary. Each computer in the system now has access to the disk or printer. The whole appeal of this device, besides the cost savings, is the simplicity. The controller only has two LEDs to indicate Busy or Ready and a power switch —that's all.

One disadvantage is that Mupet is really designed for a disk based system, and not disk and printer at the same time. This is because printer operations tie up the IEEE-488 bus so that the other systems can't use the disk during printing operations. This problem is overcome by the Double Mupet that plugs into the user and IEEE ports, thus providing an extra IEEE connector for a printer.

In actual practice, the controller decides which computer can use the disk on a first-come first-served basis. If the bus is busy, the controller automatically queues all requests for disk access. If you try to get at a file while someone else is using the disk, you'll experience a delayed response until the preceding Pet has completed its request.

Once the disk is available, the Mupet controller will automatically go to the next computer that has a request. No operator attention is necessary. Completion of this next request automatically releases the bus again for the following request in the queue. Since the bus is busy only when data is being transferred, delays will normally be brief. The only exception is when a large file is being read, which may clog things up for a while. When a printer is connected to the standard system, it also shares the IEEE bus, so nothing else can get at the bus while printing is occurring.

The Double Mupet overcomes this drawback by providing special spooling software. Anything that needs to be printed

is first written to the disk, and that image is then printed as the bus is free. The Pet can then access the disk and shared printer or it can be dedicated to control its own printer activity. In that case, the spooling program interrogates the disk at regular intervals to find the files that have been flagged for printing. The spooled files are printed on the printer attached to the computer dedicated to this task. Because printing doesn't occupy the controller, the other computers can continue to access the disk without delay.

In fact, the extra port and controller could be used to control any IEEE device, but using it for the printer is the obvious first

The ideal utilization would be to have a number of computers share the same resources.

choice. Both WordPro and Wordcraft word processors can spool print files, so using the Double Mupet in a word processing environment is ideal.

Mupet will work with any combination of equipment. Pets and CBM computers can be working together, all sharing a 4040 or 8050 disk unit or any properly interfaced printer. But more important, none of this requires any changes to programs. Mupet is transparent to the user and to most applications.

Basic, Pascal or Assembler will operate properly as well as any programs that use standard DOS commands, provided the program is operated as though it were the only user of the disk.

Some caution is necessary when you use programs that rely on sophisticated file access using Mupet. If files are not closed properly, or if some records are held in the computer's memory and then transmitted to the disk at a later time, other computers on the system will not have accurate information. The simple solution is to use programs that were designed for a multi-user installation and have taken these slight problems into consideration. As a quick example, let's look at how Mupet might be used in a word processing application using Wordcraft 80.

After the computers are properly hooked up to Mupet and the Wordcraft disk is in drive 0 of the disk drive, the program is loaded into each computer normally by typing "SHIFT/RUN." As each computer is initialized, the starting logo is displayed and printer type selected.

From this point, each operator can get documents, edit text and save information on the document disk in drive 1 of the disk unit. At a convenient time, the computer selected as the printer controller would be used to print the files needed. All other operations would be handled as if each computer had a dedicated disk and printer.

Another natural use of Mupet is in an educational environment, where the disk is used just to load programs and save some statistical data. By using this system, you can increase the speed and efficiency of the classroom computing environment and lower overall costs as well.

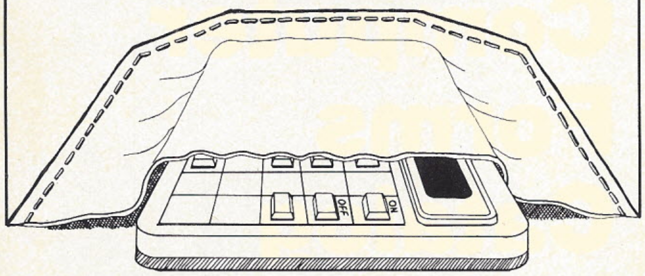
With a number of business programs, certain security measures are incorporated, such as dongles or chips that must be plugged into each computer. With Wordcraft, Commodore has a policy of supplying security dongles as a special package for use with multi-user applications, if requested through your dealer.

To use other programs that use a security device, check with the manufacturer first to see if the program will operate in a multi-user mode. Some programs will not operate, due to the architecture of the security routines.

Mupet is supplied with a controller, power supply, three interface modules and 6-ft. ribbon cables with edge connectors. □

POWER IN YOUR POCKET

by Bob McElwain



The Casio FX-702P: A Real Powerhouse

At first glance, the Casio FX-702P computer looks like the Sharp/Radio Shack pocket computer. It's about the same size and weight. It's nicely detailed. The 20-character display is similar. But the differences are significant and some are exciting.

The most obvious variation is the keyboard. The keys are arranged in alphabetical order, left to right, then continued to subsequent rows. It takes some getting used to. Each key has three functions, so that two keystrokes (pressing a function key, then the key for the function required) enter the function either in calculation or in a line of code. Since many of the functions are represented on the keyboard, the unusual arrangement of the letters and symbols is not as troublesome as it might be.

The unit is faster than the Sharp/Radio Shack unit. Just how much faster is difficult to judge. I ran Tom Fox's Prime Number Cruncher test (IA Aug 81) on the Casio. It ran in approximately 4 hours, 50 minutes. Previously, a run on the Sharp unit had taken 15 hours, 30 minutes. On other tests, the results were not quite as good. I estimate the Casio will perform most applications approximately three times as fast as the Sharp/Radio Shack unit.

Perhaps this computer's most exciting feature is that a ROM cartridge can be inserted into the body of the computer. This capability could be an outstanding asset. A small ROM cartridge can hold a great deal of code, and cartridges are easily substituted.

Some handy features

The built-in functions are extensive. Many of the commands and instructions can be keyed in with two keystrokes. There's a random number generator, both command and natural logs, and a factorial function. Degrees can be converted to decimal and conversely. Rectangular coordinates can be changed to polar and conversely. Trig and hyperbolic functions are here. A comprehensive set of statistical functions is included.

I particularly like the SET function. It allows you to establish the number of digits to be displayed. The value can be rounded or truncated.

In the brief time I've had this unit, I've formed a strong opinion about entering programs: It's difficult. There is simply not much help from the computer. For example, on entering a line of code, the line entered will be displayed. However, should an error be detected in the display, it is necessary to list the line again before editing is possible (two keystrokes plus the line number).

It is more cumbersome to handle run-time errors. Suppose line 120 has been entered as: 120 A = A/B. Then suppose in a RUN, B is incorrectly set to zero. When the program errs (division by zero is attempted), an error message displays, showing that an arithmetic mistake has occurred in line 120. To correct this, you must clear the error condition (one keystroke), change modes (two keystrokes), list line 120 (five keystrokes), and (if its a long statement) examine a lot of code to find even where the mishap occurred. When you have identified the problem, you must list the program, step by step, to find where the problem occurred (B was set to zero). If you miss the line, you must relist the program from a previous line number. There is no scroll function. In short, the editing features are limited and awkward.

A manual and a set of 73 programs are provided. The manual has no index—and therefore little value. You remember you read something, but it's difficult to find what you read if you need to refer to it.

The programs cover a variety of topics. The formulas used are clearly stated outside the programs with good supporting notes, including drawings where appropriate. The programs are mostly simple applications of formulas. In many cases, more code will be needed to make them completely functional. For example, in dealing with annuities, the rate, which cannot be computed directly, has been omitted. But certainly this is a good beginning for many applications.

It can run the Prime Number Cruncher test in about 4 hours, 50 minutes.

The list price for the computer is $199.95. The cassette interface lists at $49.95. Although the printer is not yet available, it lists at $89.95. I have been assured by the company that, unlike Sharp/Radio Shack, the printer requires the cassette interface. There is no cassette interface built into the printer. From the listings I've seen, I suspect the printing device is the same as used by Sharp/Radio Shack. The listings have the same 16-character line with indentation on line continuations. Sharp's printer unit is made by Epson.

Sharp lists its computer at $179 and Radio Shack at $229. Casio is in the middle range.

With this product release, Casio has taken a significant step into the future.

Pocket computer programs

One of the games included in the set of programs delivered with the FX-702P is called Hits and Blows. It's a 4-digit variation of the old favorite, Bagles. The following program is loosely derived from Casio's version. The code given is for the Casio unit. Comments have been included so the program can be loaded on a Pocket Computer.

To convert from Casio's Basic to that of a Pocket Computer, use the following.

PRINT for PRT
INPUT for INP
LET for ; in an IF statement
Λ for ↑ (Raise to a power)
CLEAR for VAC
A(N + 26) for A(N)

In using the subscripted variable, A(N), on a pocket computer, A(1) through A(26) use the same variable space as A through Z. A(1) on the Casio unit is the next variable beyond Z, A(27) on a pocket computer. The program is written so that A(1)-A(9) will run as stated on a pocket computer. However, these variables can be forced to the same relative position as on the Casio unit by using an offset of 26. Use A(27) for A(1), A(28) for A(2) and, in general, A(N + 26) for A(N).

The pocket computer does not have a random number generator. A possible substitution is given in the listing. Casio

has a string function called $ that can contain up to 30 characters. Other differences are noted in the listing.

Market investment analysis

A set of programs for pocket computers that provide market investment analysis is marketed by PersaSoft, Inc., Portland, OR. The basic analytical tools have been in use for some time—but this is the first implementation of these techniques on a pocket computer.

The fundamental series assists in examining investment objectives, the long-term growth potential of an industry, stock selection and market timing. The technical series assists in analyzing short-term movements of groups of stocks and the market as a whole, along with a consideration of puts and calls.

The package includes six programs and supporting documentation. The price is $14.95 per program, somewhat less per program if purchased in certain combinations. □

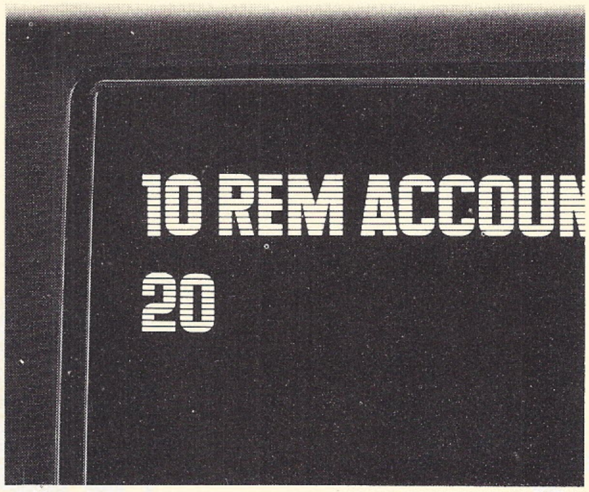
Program listing

```
   - (PC: Use PRINT for PRT.)
 5 PRT "BAGLES PLUS ONE"
   - Clear variable space.  (PC: Use
     CLEAR for VAC.)
10 VAC
   - Loop for computer's number, four
     digits.  (PC: Add 12: INPUT
     "SEED #? ";Y)
15 FOR K=1 TO 4
   - Get a random digit.  (PC: Use
     Y = Y*π-INT(Y*π): A(K)=INT(Y*10)
20 A(K)=INT(RAN#*10)
   - If the first digit selected was
     zero, get another.
25 IF A(1)=0 THEN 20
   - Continue, if digit selected was
     the first digit.
30 IF K=1 THEN 50
   - If digit selected matches a pre-
     vious digit, go back for another.
35 FOR J=1 TO K-1
40 IF A(J)=A(K) THEN 20
45 NEXT J
50 NEXT K
   @                        @
   @@@  GET/CHECK GUESS   @@@
   @                        @
   - Increase count of number of
     guesses.
100 L=L+1
   - Last semicolon causes next input
     statement to display on the same
     line.  (PC: omit last semicolon.)
```

```
105 PRT "#";L;" ";
     - Get guess.  (PC: Use INPUT for
       INP.)
110 INP "GUESS",X
     - Truncate any decimal part of
       entry.
115 X=INT(X)
     - Continue if above result is a
       four digit number.
120 IF X<10000 THEN 135
125 PRT "TOO LARGE. RE-ENTER."
130 GO TO 105
     - Break down guess into digits.
135 FOR K=1 TO 4
     - (PC: Use Λ for ↑.)
140 A(K+5)=INT(X/10↑(4-K))
     - Remove the digit assigned
       above, from X.
145 X=X-A(K+5)*10↑(4-K)
150 NEXT K
     - Check that no digits were dup-
       licated on entry.
155 FOR K=6 TO 9
160 FOR J=K+1 TO 9
     - If a digit is duplicated, re-
       turn for re-entry.  (PC: Use
       <> for ≠)
165 IF A(J)≠A(K) THEN 180
170 PRT "NO DUPS. RE-ENTER."
175 GO TO 105
180 NEXT J
185 NEXT K
     @                @
     @@@  BUILD CLUES @@@
     @                @
     - Count digits correct and in the
       right position, FERMIs.
200 N=0
205 FOR K=1 TO 4
     - (PC: Use LET for ;)
210 IF A(K)=A(K+5);N=N+1
215 NEXT K
     - Exit to win if four correct.
220 IF N=4 THEN 360
     - Count number of digits right
       but in the wrong position,
       PICOs.
```

```
225 M=0
    - Index for digits of guess.
230 FOR J=1 TO 4
    - Index for digits of computer's
      number.  Compare all digits of
      the guess to all digits of the
      computer's number.  (PC: Use
      LET for ;)
235 FOR K=1 TO 4
    - Ignore compare if both digits
      are in the same position.  Al-
      ready counted as FERMIs above.
240 IF K=J THEN 250
245 IF A(J+5)=A(K);M=M+1
250 NEXT K
255 NEXT J
    @                        @
    @@@   OUTPUT RESULTS   @@@
    @                        @
    - Assemble guess for output.
300 Z=1000*A(6)+100*A(7)+10*A(8)+A(9)
    - Assemble clues.  (PC: Use 305:
      FOR K=6 TO 9  306: A$(K)=""
      307: NEXT K  308: T=5)
305 $=""
    - Add for FERMIs.
310 IF N=0 THEN 330
315 FOR K=1 TO N
    - (PC: Use 320: T=T+1: A$(T)=
      "FERMI")
320 $=$+" FERMI"
325 NEXT K
      Add for PICOs.
330 IF M=0 THEN 350
335 FOR K=1 TO M
    - (PC: Use 340: T=T+1: A$(T)=
      "PICO")
340 $=$+" PICO"
345 NEXT K
    - (PC: Use PRINT Z;A$(6);A$(7);
      A$(8);A$(9) )
350 PRT Z;" ";$
355 GO TO 100
    - Win.  Return for new game.
360 PRT "FOUND IN";L;" GUESSES"
365 GO TO 10
```

BOY, IS THIS COSTING YOU.



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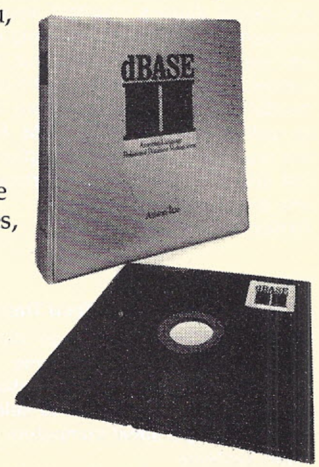

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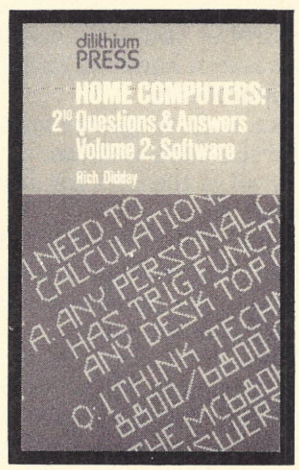

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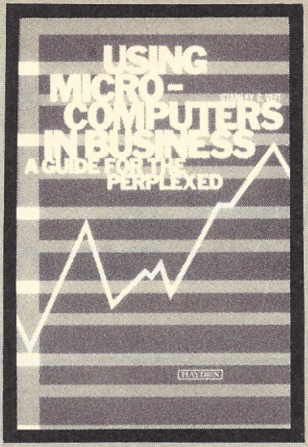

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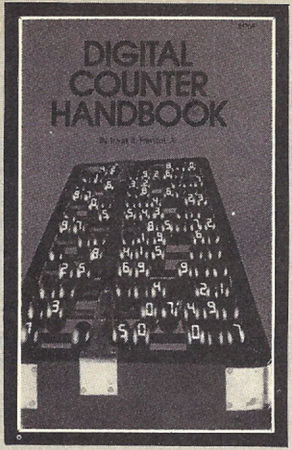

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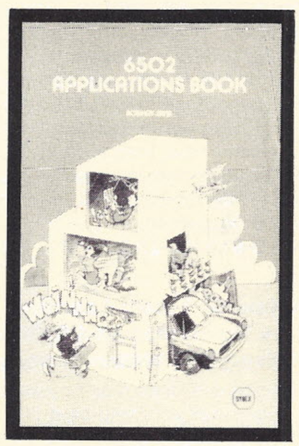

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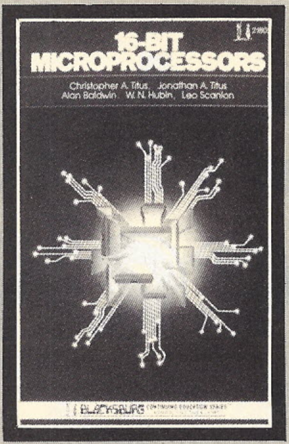

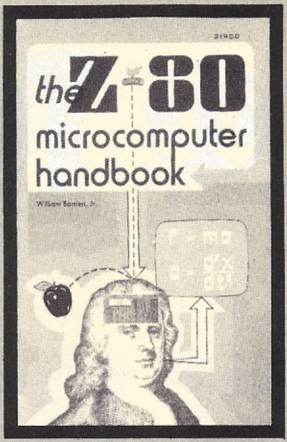

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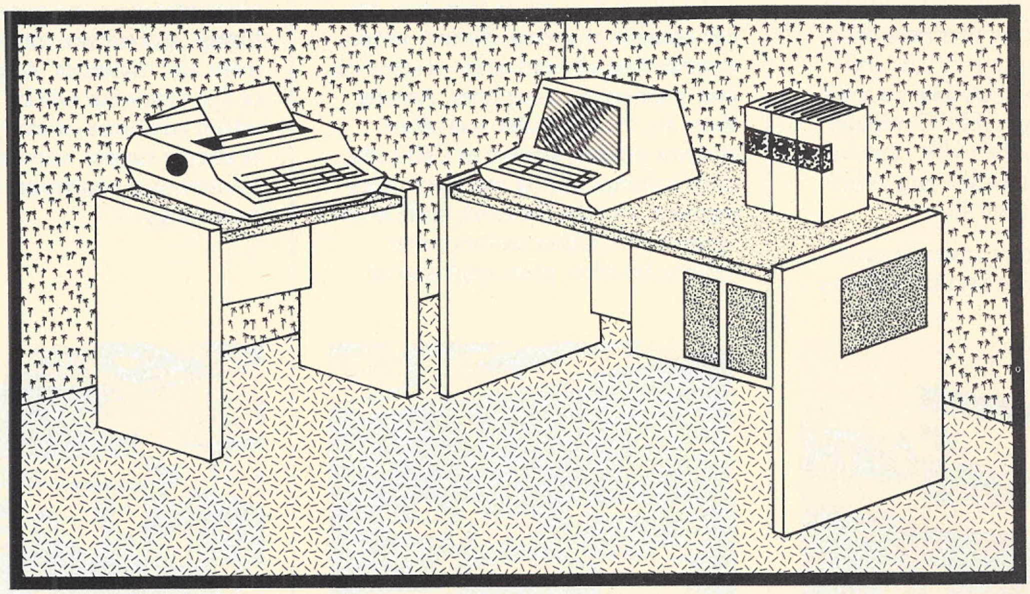

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by Hillel Segal

There's an old axiom in the world of business: you get what you pay for. Like many such sayings, it isn't always true. In fact, it's quite a challenge trying to figure out when that rule applies and when it doesn't. The benchmark tests are one method of finding out whether the rule is operating properly or not.

Although computers can be rated according to speed and capacity, no one would suggest that those ratings be the sole basis for evaluation. The benchmark tests performed for the Association of Computer Users by independent consultants are standardized applications and repetitive speed tests. Comparisons of run times of similarly-priced computers tell us something of the speed of the processor, operating system, language and peripherals—more than just hardware specifications could. But it's up to the reader to decide to what extent sheer speed is important in a particular situation.

This month's system is at the high end of the target price range for this group of benchmark tests. This series focuses on computers costing under $15,000. The Alpha Micro AM-1011 has a price of $15,605 for a complete one-user system.

The money appears well-spent, at least in terms of performance, since the system posted excellent times over a broad range of tests. In several categories of testing, it was best of the group.

In the accounts receivable problem, a test simulating a "real life" set of accounts, the system was not out in front. But it was among the leaders, with a time of 3 minutes, 25.3 seconds for the test. A short compile step prior to the run took about 10 seconds.

A floating point math processor, speeding up numerical calculations, undoubtedly helped the system to post some low run times. The floating point hardware is a standard feature.

The unit was tested at a customer site, independent of any factory assistance, because the company chose not to participate. Nevertheless, the testing process went without a hitch. The more expensive AM-1051 computer was also run through the benchmark process for a report in the ACU's series 3 benchmarks, covering the $25,000-$50,000 class. It performed well in those tests, which include multi-user response time ratings.

As tested, the AM-1011 included an AM-100T processing unit, 64,000 characters of memory and two floppy disk drives, storing a total of 2.4 million characters. A Lear-Siegler AMD-3A + terminal and a Texas Instruments 820 printer rounded out the hardware.

Standard software items included the AMOS multiuser operating system, extensive utilities, text editor and formatter. Three high-level languages are supplied: Basic, Pascal and Lisp, all Alpha Micro versions.

A similar but slightly less expensive system is the AM-1010, which uses an AM-100 processor, operating at ⅔ the cycle time (2 MHz), and performing memory operations eight bits at a time. (The AM-100T is a true 16-bit processor.) Either system can be used with hard disk drives of varying capacities, as well as tape drives.

One of the computer's strongest qualities is the ability to expand the unit from a simple single-user system based on floppy disk storage to a hard-disk multi-user configuration. Up to four hard disks can be added, and as many as 24 terminals can be connected.

Versatile operating system

The operating system is designed to work with the largest possible configuration, and offers several features for use in managing the computer's use. In addition, a full line of utilities for file and disk management is included, and a number of debugging aids is provided in the Basic environment. These include breakpoints and single-step operation.

The AlphaBasic language had a number of features not usually found. Variable names can be of any length, labels may be used in place of line numbers to identify locations in the program and the programs may be chained together. In the interactive development mode, a line-by-line syntax check is performed to spot errors early. Once perfected, a compiled version of the language may be stored for later use.

While the AlphaBasic itself does not include a built-in line editor (changes must be made by retyping the entire line), the utilities include a text editor, called VUE, which provides the necessary functions for editing programs under development. Word processing can be accomplished by using the VUE editor, along with a text-formatting utility.

One interesting type of flexibility the system provides is the ability to use nearly any non-intelligent terminal as a workstation, since software for many common CRTs is included in the operating system. The cursor positioning systems of these inexpensive terminals are used together with the computer's screen editor to allow sophisticated terminal operations normally associated with more expensive CRTs.

Diverse manuals are helpful

Documentation reviewed prior to the benchmark testing was found to be complete and well-written. An excellent manual that introduces the first-time computer user to the system was available, as well as more detailed manuals for system operators and managers. Specialized programming manuals covered the higher level languages, the assembly language and interaction with the operating system.

Software packages supplied include general ledger, accounts payable and receivable, order entry, inventory control and payroll. OEMs who sell turnkey systems supply much of the software in use by customers.

The dealers who sell the Alpha Micro systems provide most maintenance service. Board replacement in the field is combined with factory board service. Some of the users contacted had complaints about dealer service, but for the most part, customers said they had good relationships with their dealer.

About 15 end-users were surveyed during the benchmark report process; about one-third of them had a single terminal. Others had two or three terminals attached to their system. Businesses included retailers, distributors, a mail order house and engineers. Two systems were being used by individuals engaged in personal research.

User comments on the languages and operating system were universally favorable. "I purchased the Alpha Micro because of price and language. Now, with hindsight, I purchased a powerful operating system as well," said one customer. Another told us, "I'm used to working with a million-dollar computer...and I don't find myself limited on the Alpha Micro."

Most of the users had a solid background in computers and were able to develop their own software as well as refine that of others. Their interest in the Alpha Micro, they said, came from price, expandability, ease of operation and a versatile, sophisticated operating system. □

Hillel Segal is president of the Association of Computer Users, a non-profit association with members all over the U.S., Canada and several foreign countries.

One of the association's key activities is the publication of its Benchmark Reports. Each month a new report is produced covering a computer system.

In addition, ACU publishes seven bimonthly newsletters for users of small computers, midi computers, large computers, time-sharing systems, distributed processing systems, word processing systems and home and hobbyist computers.

A complete package of information about membership is available at P.O. Box 9003, Boulder, CO 80301.

Hardware Evaluation

A PRINTER POTPOURRI

Enhancements to the Epson product line

by Roger H. Edelson

Within the past few months, Epson (Torrance, CA) has begun shipping three new products: 1) a lower cost addition to its printer line—the MX-70, 2) the model 8150—a full-fledged RS-232 serial interface and 3) the Graftrax 80 (a bit plot graphics capability for the MX-80 printer line). All of these items have served to enhance Epson's already formidable position in the printer marketplace.

The MX-70 (pictured here) brings the excellent Epson dot-matrix printing to the low end personal computing market with only a slight reduction in the features and specifications that made the initial Epson offering (the MX-80) so popular. The unit uses a somewhat simplified printer head mechanism that provides 5 by 7 dot matrix impact printing at 80 characters per second (the same speed as the MX-80). The full ASCII character set (96 characters) is provided by the MX-70. However, descenders may only be obtained through the use of the graphics capability. Most of this character set is shown in figure 1, which is a copy of the printout produced when the self-test function is energized.

In addition to the full ASCII character set, available in the text mode, the printer also provides a BIT-IMAGE graphics mode with a resolution of 72 by 60 dots per inch (vertical by horizontal). In the text mode the MX-70 differs by providing only unidirectional (vs. bidirectional) printing in both 40 or 80 column width with both normal or enlarged character sizes, unlike the 12 different combinations available in the MX-80.

The MX-70 retains the look and feel of the original MX-80, maintaining the same low profile, the same snap-in ribbon cartridge, a large external paper movement knob, and most importantly—the extremely easy user replaceable print head. This makes user serviceability of the printhead a 5-to-10 minute operation, plus a trip (or a mail drop) to an Epson dealer for the less-than-$50 replacement head. The fact that the company has made the printhead so easy to service does not imply that one should expect an early retirement of the head—it is good for over 50 million characters, which translates to a lot of printing.

To produce high quality printing in this lower cost printer, the company has removed a few operator controls—the ON LINE/OFF LINE control and its associated indicator (not the ON/OFF switch) and the FORM FEED control. While the ON LINE/OFF LINE control removal will probably not be greatly mourned, I would have liked to see the retention of the FORM FEED control. It is a handy method of advancing the paper for removal after the completion of a printing job without the need to carefully reposition the paper at the top-of-form position. The MX-70 does, of course, retain the software controlled form-feed that will move the paper vertically to the next predetermined top-of-form position. This command is represented by the mnemonic FF, and is commanded by transmitting the Hex code OC, but retention of the manual pushbutton would still have been nice.

As a standard feature, the printer also incorporates a BIT-IMAGE mode for generating illustrations, charts and other graphic tasks. This mode is provided through user access to each of the eight dot wires in the printhead, providing a maximum of 480 dot positions per printable line.

Watch the bit positions

While the results obtained using the BIT IMAGE graphics mode are quite satisfactory, operation of the MX-70 in the BIT IMAGE mode is not particularly easy. As the printer provides for the ability to mix both graphics and text on the same lines, the computer must indicate (to the printer) the number of bit positions per line (to a maximum of 480) to be treated as bit image data. All information following the number of positions devoted to graphics is then treated as text by the printer. Further, at the end of each line, the printer reverts back to the text mode and the operation must be performed again—forcing a slight increase in the software overhead when printing graphics.

Another feature missing from the MX-70 is a serial interface capability. While the printer does support a parallel Centronics interface, there is no provision for adding the serial interface adapters available for the MX-80 and MX-100 printers. In most installations, this will not be a major problem, as almost all computer systems provide a parallel output port that may be software configured as the printer port.

Let's take a look at the Graftrax 80 bit-plot graphics package now available to retrofit into the MX-80. The package is supplied as three 2716 EPROMs and a complete instruction manual, covering both the installation and use. The installation instructions run a full page, detailing the method of removing the printer case through the modifications that need to be made to the switch settings for proper operation. With the EPROMs installed, the printer may be hardware configured in various type modes from italics to slashed zeroes, even including either 80 or 132 characters per line.

These two type styles (both normal and italic) that are now available under either hardware or software control are shown in figure 2, a composite of different self-test printout made by changing the printer configuration through the use of the SW-1 switches. Rather than list all the function codes available with the new operating system, it is more illuminating to simply mention the new features. For starters, the bell sound has been shortened to a much more civilized ⅓ of a second from the original three-second period. The printer now supports a BACKSPACE CHARACTER mode, and the EMPHASIZED mode and the COMPRESSED mode can be used anywhere, and at any length, on any line. These features remove some of the difficulties associated with the earlier version of the operating system—it was particularly galling not to be able to have CONDENSED mode characters intermixed with other type styles anywhere on the line. These revised features, by themselves, are worth the rather minimal cost associated with the purchase of the Graftrax 80 option (about $100).

```
BCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abc
CDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcd
DEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcde
EFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdef
FGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefg
GHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefgh
HIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghi
IJKLMNOPQRSTUVWXYZ[\]^_`abcdefghij
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KLMNOPQRSTUVWXYZ[\]^_`abcdefghijkl
LMNOPQRSTUVWXYZ[\]^_`abcdefghijklm
MNOPQRSTUVWXYZ[\]^_`abcdefghijklmn
NOPQRSTUVWXYZ[\]^_`abcdefghijklmno
OPQRSTUVWXYZ[\]^_`abcdefghijklmnop
PQRSTUVWXYZ[\]^_`abcdefghijklmnopq
QRSTUVWXYZ[\]^_`abcdefghijklmnopqr
```

Figure 1. MX-70 self-test printout (character set)

Changes have also been made to the horizontal and vertical tabbing characteristics, giving the operator more control over the vertical and horizontal formatting. Features have also been included that make the printer much more friendly when used with the TRS-80 computer family. Further, it is now possible for the user to redefine the escape sequences used to access the many features of the printer. All of these commands are stored in the printer, and remain in effect until the printer is reset or power is removed. Besides providing the facility to place the printer in the italics mode when desired, the Graftrax 80 does what its name implies—allows the printer to operate in the BIT-IMAGE graphics mode.

In the graphics mode, the MX-80 can now produce charts, pictures and graphs—the various uses are limited only by the imagination and software of the user. Figures 3 and 4 show two graphic printouts produced by the MX-80 using the Graftrax 80 system, driven by an Apple II computer with an Interactive Structure Inc. model EP12G interface. Figure 3 shows a representation of a U.S. dollar coin, and figure 4 provides a printout that simulates a multi-pen stripchart recorder. For many scientific and engineering applications, the second of these two figures is much more impressive than the picture of the coin. For just a small sum, it is now possible to use your computer as a process recorder—what a find.

The last item to be reviewed is the new serial interface adapter (model 8150) available for the MX-80 series and MX-100 printers. It is quite appropriate to mention this device along with the Graftrax 80 system because (when using a serial interface) the bit image graphics portion of the Graftrax 80 will not operate without the Epson 8150 serial interface board. The other features of this operating system will, however, still function including the italics style and the slashed zero typeface. The Graftrax 80 will operate without any serial interface, of course, if you are using a parallel interface, but many systems don't have this interface mode available.

The 8150 Serial Interface, designed as a plug-in module, is simple to install, requiring only the removal of the printer top-cover and the installation of four hold-down screws. Of course, if you are buying your printer

equipped with a serial interface, just specify the 8150 and there will be no need to affect an exchange. The new serial interface board now contains a full 2K buffer to eliminate buffer overrun and provide character storage facility when in the BIT-IMAGE graphics mode. The 8150 allows the use of either RS232C or Current Loop

```
()*+,-./0123456789:;<=>?@ABCDEFGHI
)*+,-./0123456789:;<=>?@ABCDEFGHIJ
*+¥#$%&'()*+,-./Ø123456789:;<=>?@A
!"#$%&'()*+,-./Ø123456789:;<=>?@AB

!"#$%&'()*+,-./0123456789:;<=>?@ABC
"#$%&'()*+,-./0123456789:;<=>?@ABCD
#$%&'()*+,-./0123456789:;<=>?@ABCDE
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!"#$%&'()*+,-./0123456789:;<=>?@ABC
"#$%&'()*+,-./0123456789:;<=>?@ABCD
```

Figure 2. Graftrax 80 typestyles

Figure 3. Bit-image print of U.S. dollar coin

transmission between the host computer and the printer.

The new serial inteface adapter now provides a self-test feature, which also prints the status of the interface —a nice thing to have. It will indicate that the full 2K memory is operable—with the protocol selected for the busy line interface and the data condition. An example of the printout obtained when the self-test mode is operated is shown in figure 5.

When operating as a part of the computer-printer interface, the operation of the 8150 is completely transparent to the user—as it should be. The microprocessor controlled adapter signals a busy condition when there are 2,032 characters stored in the buffer, and provides a printer-ready status when there are 1,896 or fewer characters stored. The BUSY line may be configured for either normal, or inverted levels, depending on your system interface protocol. In my system configuration, it was necessary to implement the DSR (Data Set Ready) handshaking protocol to enable proper operation of the interface. Once this function was implemented, it was possible to operate the printer and any of the available serial baud rates (300 to 19.2K) without a problem. With the older style (8141) interface, I was only able to operate at 9600 baud.

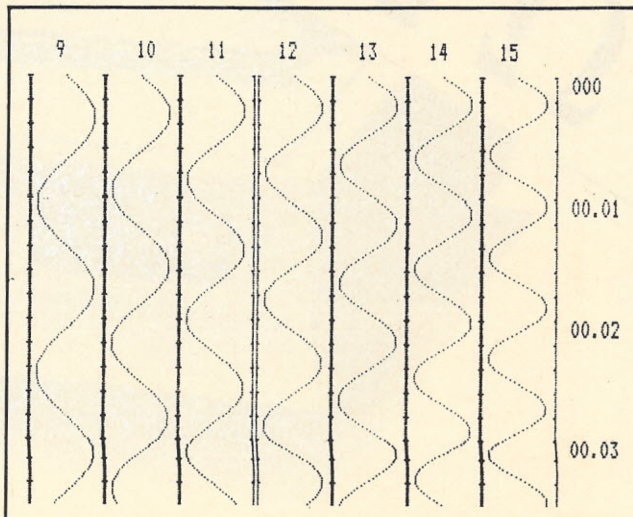

Figure 4. Simulated multi-pen strip chart using bit-image mode

```
2K MEMORY BUSY/DATA OK
 !"#$%&'()*+,-./0123456789:;<=>?@ABC
pqrstuvwxyz{|}~ !"#$%&'()*+,-./01234
abcdefghijklmnopqrstuvwxyz{|}~ !"#$%
RSTUVWXYZ[\]^_`abcdefghijklmnopqrstu
CDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdef
456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVW
%&'()*+,-./0123456789:;<=>?@ABCDEFGH
uvwxyz{|}~ !"#$%&'()*+,-./0123456789
fghijklmnopqrstuvwxyz{|}~ !"#$%&'()*
WXYZ[\]^_`abcdefghijklmnopqrstuvwxyz
```

Figure 5. Self-test example

With the addition of the MX-70, Epson has filled a hole at the low end of its printer line, and has made available a remarkably excellent printer for the personal computerist marketplace. In fact, small businesses with only occasional hard copy output requirements would do well to consider this printer as a very cost-effective acquisition. The other two items reviewed (the Graftrax 80 package, and the 8150 serial interface adapter) perform their functions just as expected. They provide valuable enhancements to the already excellent capabilities of the MX-80 line. □

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Tips on Selecting a Small Business Computer

by David Benevy

We all know the age of computers for small business has arrived. The advertisements tell us so, as do the computer magazines and even the popular press. Yet a very substantial percentage of small businessmen who purchase their first computer are disappointed in the outcome—not because there is no computer right for their operations, but because they picked the wrong one. Often they must return to the marketplace, poorer

but wiser, and choose their second system on the basis of what they learned (the hard way) from their first.

I don't know how many small businesses go through this trial-and-error process, but the number is high. As a turnkey system developer, I have talked to dozens and received letters from others. On the basis of this experience, it is possible to isolate the lessons they should have learned earlier and the questions they should have asked. Let's try to pinpoint such questions and suggest some answers.

Following are some letters written by users who now have satisfactory systems—we can observe what they learned from their earlier experience. One person in the equipment rental business, said:

> "I looked at various alternative computers for our company...I selected a popular microcomputer and counted on using its canned programs. After buying them, however, I found that they had bugs and also were not applicable to the rental business. I retained a programmer and found that this model didn't have the capacity to handle my business."

Although this user did eventually find a computer system that served his needs, his early problems are instructive. Software and people are at least as important as hardware. That's a lesson learned by many first-time computer owners on their way to becoming second-time owners.

Here's what a multi-office law firm said:

> "We first looked at our own computer capability because the service bureau we were using was totally inadequate in their ability to provide us with prompt, accurate work. All in all, we feel that our new small-business computer provides more flexibility than was possible on a mainframe. In addition, we have been able to personalize the system directly to the needs of this particular firm."

Note that both of these users base their satisfaction on what their second system actually does for them—what their first one did not. Their satisfaction has little to do with hardware or theoretical computer capacity. They have learned that a computer system is more than merely hardware and software. The system also includes people—lots of them. People who will be involved in your computer information loop include company management who will want specific information in a specific form. Others involved are those who will supply your computer, program it, operate it, maintain it, service it when it breaks down, modify it when needed and maybe abuse it.

Look beyond the hardware

Whatever you do, don't start your computer selection process by looking only at hardware and how much it costs. Instead, start by asking, "What do I want a computer system to do for me?" But if you are a first-time user, chances are you may have a problem answering that question. Here are some starting points.

Experience shows that the two most valuable functions of a small-business computer are record-keeping and word processing. Record-keeping most often includes accounts payable, accounts receivable, general ledger, inventory and mailing lists. If you need these functions or others, make sure your computer can perform *all* of them satisfactorily. Maybe your business also could use automatic follow-up, correspondence or time-keeping. Write down all of these functions. The more detailed your information—including the value you put on speed, the probability of frequent program changes, etc.—the better your position will be when you start looking at hardware, and software.

It is probably at this stage—the very first step in computer selection—that the most disastrous choices of first computers for small businesses are made. The buyers may wind up choosing a multi-purpose system that is alleged to be good for everything—game playing, education, household account-keeping and small business.

If you ever hear that kind of claim, don't bother unpacking your list of needs, just head for the door. The system in question won't do all these things any more than a sub-compact car can meet your needs for commuting, family travel, carrying cub scouts and hauling over-the-road bulk cargo.

Expandability is important

Try not to think of computer capacity in terms of bits or bytes, no matter what popular opinion says. After all, what does "64K of memory" really mean to you? One computer may allow you to store only 500 names on a mailing list, while another with the same size memory and better software, could give you 2,000 names. Much more important than initial size is the question: Is this computer expandable? Can I add a terminal if needed? Can I put more floppy disks into the machine? Can I add hard disks for even greater capacity?

Of course you expect your business to grow. In five years you'll be ten times as big. But you're not installing ten times as many production machines right now—or rushing out to rent ten times as much warehouse space as you currently need. You'll expand those capacities when you need them. You should be choosing a computer on the same basis—rather than paying for grossly excessive capacity now in case you might need it sometime in the future.

People in the computer manufacturing business don't like to talk about the possibility that computers might break down once in a while. But the basic fact of life is that your computer will not always work. So ask yourself: How important are reliability and fast service?

Unfortunately, reliability is almost impossible to judge. Of course, you should ask other users of the same equipment, if you can find them, about their experience. If you're considering a brand-new design however, it might represent a price breakthrough. Thus you won't find other users to ask. Unfortunately, there is more than a remote possibility that the new unit might not be as reliable as one that's been out in the field for a few years.

Sooner or later you will have a problem of your own requiring service. What then? Will you have to pack it on your back to a regional service center? Mail it to Nome, Alaska? Look in the yellow pages for a Job Corpsman specializing in electronics.

Chances are, you want the assurance that your unit can be fixed at your place of business—preferably under a manufacturer-backed service contract. Such agreements usually exclude certain situations—decimation by fire or pulverization by earthquake, for example. But they generally assure you that parts and labor will be available at a fixed price per year. If such a contract

is not available—or if it is priced very high—beware. This sounds elementary, but whenever you price a computer, get a clear answer as to what the price includes.

It almost always includes the CPU. But does that "low cost" computer include a terminal, or will you start paying extra for CRT (cathode ray tube) and keyboard? How about print-out? Will you have to supply your own electric typewriter (limited to a relatively low speed of a few hundred words per minute) or does the system include a high-speed printer, delivering several thousand words per minute? How about the quality of these peripherals? Today there are a limited number of manufacturers of disk drives, terminals and printers. Find out who they are and which ones are high quality. There's no sense having a computer if you have trouble getting information into it or out of it.

If you are going to pay extra for necessary peripherals, add their cost into the purchase price. A $2,000 computer plus a $2,000 terminal and a $3,000 printer and a $5,000 software package is a $12,000 system, no matter what the ads say. Whether those diverse, unmatched components will actually work together as a system is another question.

Software—the programs that make your computer perform useful work instead of just sitting there blinking at you—is harder to judge than hardware.

A good test is to watch the computer run. If possible, load it with a sample of your own devising—your mailing list entry, for examply and your daily time sheets or invoices.

It's also important to read the documentation. If it doesn't make sense, ask the salesperson to explain it.

Finally, talk to people who use *this* software on *this* computer. This should be the best gauge of all, but some people hate to admit (or don't even know yet) that they bought a lemon. Still, asking should help you to avoid some mistakes.

There is a legendary bird called the Killyloo that locomotes through the air backwards because it is overwhelmingly interested in where it has been. If you are to rely on your computer for accounting records, you will want (like the killyloo) to be able to trace the background and history of each accounting entry. In accounting language, you'll want an audit trail. For example, you don't want some unauthorized person to carry out midnight transactions with no record of what happened to all that cash or all that inventory. Or, if a mistake should creep into the record, you want some printed document that enables you to spot the offending transaction and correct it. The IRS may demand an audit trail too. If in doubt, ask your accountant.

Check for ease of use

It would be simple to make a joke about how easy computers are to use, because *every* system manufacturer says his are easy. The fact is, however, that some are easier than others.

How do you find out if the system you have in mind is really easy to use? The best way is to learn to operate it yourself. If that's not feasible, watch someone else use it and see what the operator has to do.

Ask: "How long will my people have to go to school?" If the answer is a week or so, you may begin to suspect that the system is not the world's easiest-to-use. The longer the training, the more money this software will cost you in the long run because you'll be training new employees, vacation replacements, operators of second terminals and maybe a second shift.

Another good question to ask is: "How big is the manual?" If it's 500 pages and weighs several kilos, this may indicate a certain over-complexity. On the other hand, inadequate documentation isn't desirable either. Look at the manual. Make your own evaluation. Ask other users or even "computer experts."

If you have been shopping for a computer very long, you may have learned to detest the word "flexibility." It is used often by hardware people and defined very seldom. Here's my definition: A truly flexible computer system is one in which you can make changes without taking too much time (to write and debug an all-new program, for example) or paying a high price for a professionally rewritten program. Such programming can cost thousands of dollars.

The best advice is to choose a system that is flexible to begin with.

How important is flexibility? Well, if government tax regulations or even tax rates change (which they often do), you'll have to change your program. If the post office issues new zip codes, this could destroy the value of some mailing list programs. Or if you expand your sales territory from eight to ten regions, you want it to be easy to break the news to your computer.

Who is going to tell your computer about changes in its work rules? You could do it yourself—maybe—if you want to become a computer programmer. Or perhaps you could ask the person who wrote the software—if you can find him; or the company he worked for, if they're still in business; or the store from which you bought the computer.

The best advice is to choose a system that is flexible to begin with. For example, can you assign your own names and values to mailing list categories? When it comes time to add a south by southwest region, can you plug it into the program yourself in a minute or two at no cost? Further, you should buy from a vendor who has an interest in updating programs on his own, and for making them available to both future and past purchasers.

Choose a vendor you trust. Ask other customers what happens when they call him with a problem. Good service? Prompt service? No service? This is very, very important. As a first-time buyer, you are blessed with very little other protection.

You may have found most of the topics raised here a little discouraging. You think maybe you'll never even be able to buy your second computer without making mistakes buying your first one. You feel you won't be able to fully judge a system until after it's up and running. But if you take care to choose a sound system at a reasonable price that will do what you expect it to, you should be safe. Furthermore, you may find that the best is yet to come. It likely will turn out to do a lot of good things that you didn't expect. And it will do them faster, easier, cheaper, more effortlessly than you ever dreamed possible. □

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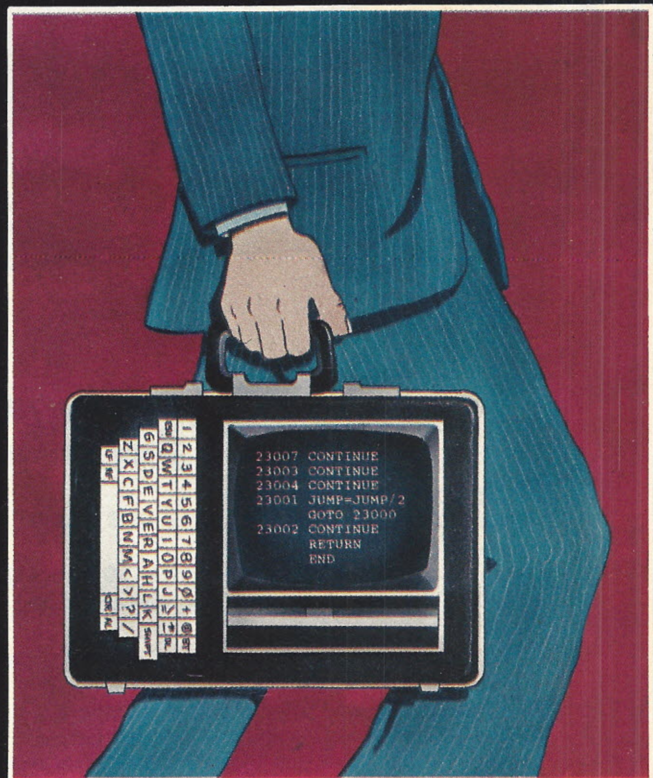
THE PORTABLE COMPUTER IS HERE

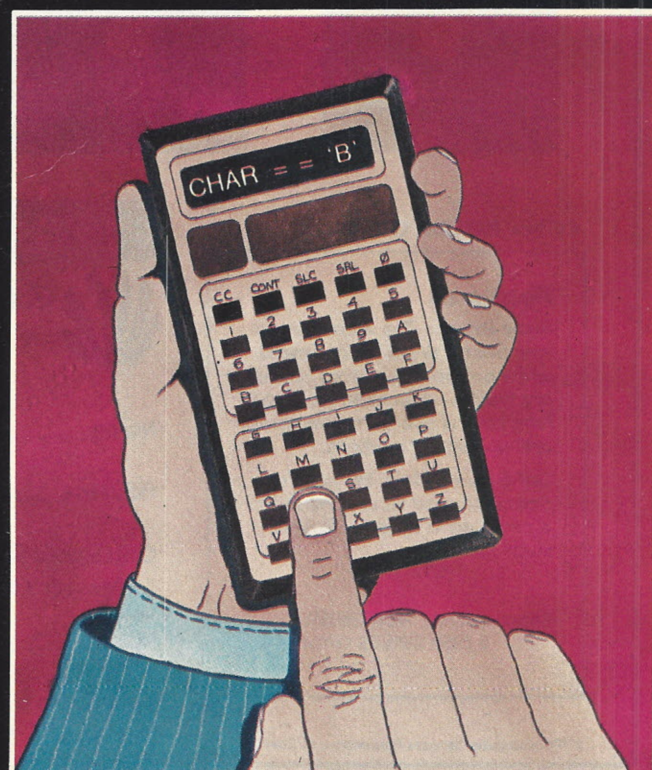
by Bernard Conrad Cole

With the success of the Osborne 1, Sinclair's ZX80 and Radio Shack's pocket computer, it is becoming clear to many manufacturers that the key to turning the personal/small business computer market into a multibillion dollar proposition is portability. But so far, portable computers have only achieved a partial success. Devices such as those from Sinclair and Radio Shack have obtained amazing portability, but only at the cost of considerable sacrifice in computer power. The Osborne 1, however, takes a step in the right direction with a computer that has all the power of many desktop and hobby computers—while achieving semi-portability.



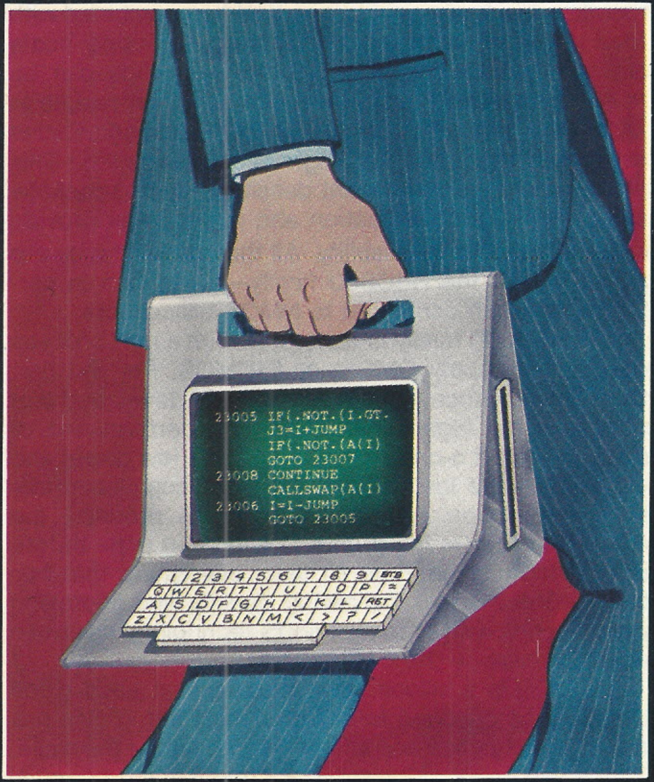
The limitations of the Osborne 1 indicate what must be done to achieve a truly portable computer. First, there is the problem of the display. One of the parameters that placed a limit on how small the Osborne 1 could be was the CRT display. Even though one of the smallest available CRTs was used (at some cost to viewing ease), its physical measurements dictated that the Osborne 1 could not be reduced much beyond the size of a portable sewing machine.

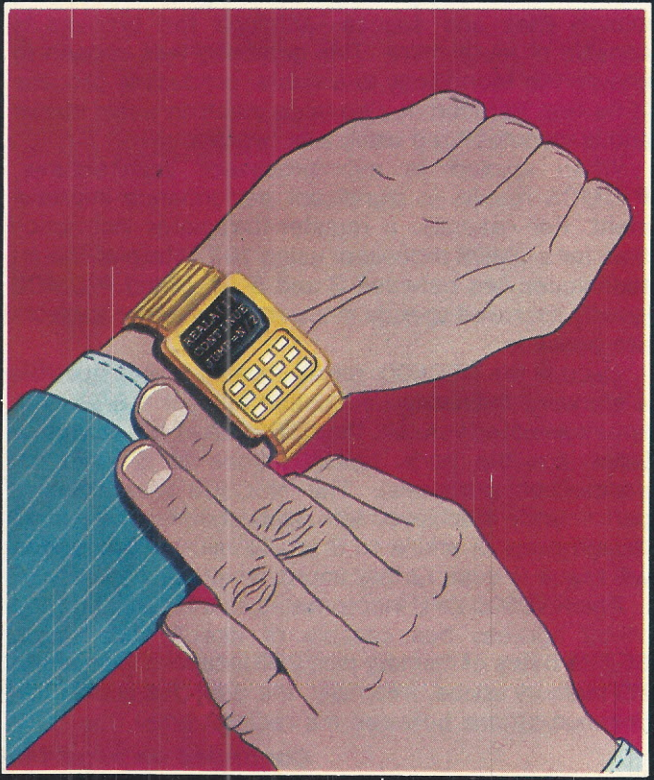
Secondly, there is the matter of power requirements. Aside from the disk drive, the requirements of the electronics—CPU, memory, CRT driving circuitry— make true portability out of the question—at least in the same sense that a tape recorder or radio that operates off flashlight batteries is portable. There is a battery pack available, but it weighs several pounds and lasts only a matter of hours.



It is clear that for the truly portable computer (small enough to fit in a brief case but powerful enough to be used for the same types of functions as an Apple II, a TRS-80 or a North Star Horizon) to become a reality, there are at least three requirements. First, microprocessor and memory components must require only a fraction of the power now necessary. Secondly, displays that weigh very little when compared to a CRT and can be fitted into very small spaces will be essential. Finally, displays that are comfortable to look at and do not reduce the size of the alphanumerics to almost gnat-sized dimensions must be available.

Fortunately, current developments will allow system designers to meet these requirements with ease. It appears that the first requirement can be satisfied with a low power semiconductor technology (complementary MOS) that is now coming into its own. It is used to fabricate memory and microprocessor components that





require only thousandths of watts per component compared to the one watt per device with present technology. Also a number of flat panel display technologies are emerging from the laboratories that appear to solve the other mentioned requirements.

Only with the advent of complementary metal oxide semiconductor technology (CMOS) has it become possible to produce electronic devices capable of extremely slow power usage. Hence many systems that require batteries can be designed within the limitations of small physical size. Digital watches, for instance, were made possible only with the development of CMOS digital circuits. And Radio Shack's so-called pocket computer, as well as the Sinclair ZX80 are based on custom CMOS circuits.

In order to understand the advantages of CMOS transistor technology, it is first necessary to understand the operation of its predecessor technologies: p-channel MOS (PMOS) and n-channel MOS (NMOS). PMOS circuits, used in the fabrication of the first handheld calculators, are made of transistors consisting of three elements—the source, the drain and the gate. The gate controls the current flow between the source and the drain. In this device, when a negative voltage is applied across the gate terminal, a field is set up across the gate dielectric, which produces a conductive path between the source and drain. The voltage at which the conduction occurs is known as the threshold voltage.

Similar in structure to PMOS, the more recent NMOS transistor has a substrate that is a p-type silicon; source and drain are n-type, rather than vice versa in PMOS. This difference makes possible higher speed and higher density. Thus it has been used to fabricate most of the industry standard microprocessors and memory devices, including the 8080 and the Z80.

CMOS devices combine both NMOS and PMOS into the same transistor structure. The result of this combination is low power and high reliability. What it has not offered until recently is the high speed and high density of the present generation of large scale integrated NMOS circuits. The reason for this is not technological—but competitive. NMOS development has been pushed very hard by memory technoiogy demands; CMOS has not. Because of this phenomenon, there are few CMOS circuits as fast as their NMOS counterparts, even though CMOS is twice as fast as NMOS for a given geometry (requiring

$\frac{1}{20}$th to $\frac{1}{100}$th the power).

Numerous semiconductor companies have applied the expertise developed in pushing NMOS technology to its physical limits to CMOS. Within a short time, we can expect numerous microprocessor and memory components to be introduced and eventually incorporated into increasingly portable personal computers.

The reason for this radical shift in emphasis from NMOS to CMOS is that in making the shift from LSI (large scale integration) to VLSI (very large scale integration), NMOS circuit designers have run into a thermal barrier, due to excessive power dissipation and IC package power dissipation constraints. In many present generation devices, the heat generated by the LSI circuits is often in excess of one watt. As the integration increases from the tens of thousands of devices per circuit to hundreds of thousands, the heat that must be dissipated could be intolerable.

NMOS LSI circuit designers have been aware of this thermal barrier for years and have used circuit innovations such as dynamic circuitry, edge triggering plus lots of clocks to keep power dissipation within reasonable limits. But most of the NMOS power conserving tricks have been invoked. What is called for is a process that is not up against a thermal barrier—and CMOS is the answer.

Most of the major Japanese and European semiconductor firms have developed CMOS VLSI processes, as have most American microprocessor and memory component manufacturers including Intel, Texas Instruments, Motorola, National Semiconductor, Intersil, Mostek, Harris and Signetics.

Although not the only family of CMOS microprocessors, National Semiconductor's NSC800 is certainly typical of the advantages of this technology. A CMOS system based on NSC800 components consumes less than $\frac{1}{20}$th the power than comparable NMOS microprocessors such as the 8080, 8085 and Z80.

The NSC800 family combines the best features of both the Z80 and 8085. The new family includes three primary components fabricated using its own proprietary CMOS VLSI process called double polysilicon CMOS. The NSC800 CPU is capable of 1 μs instruction cycle times while dissipating only 5% of the power consumed by comparable NMOS CPUs. The NSC810 RAM-I/O timer and NSC830 ROM-I/O, two dedicated peripheral devices also fabricated with double poly CMOS, provide memory and general programmable interface capabilities with the same high performance/low power characteristics.

The 40-pin NSC800 CPU combines the multiplexed address/data bus structure of the 8085 with the register structure and instruction set of the Z80. The dedicated memories (NSC810 and NSC830) incorporate on-chip logic to interface directly with the multiplexed bus. Combining the three devices results in an efficient design that significantly reduces chip count as well as power, without degrading system performance.

According to Anne Wagner-Korne, National Semiconductor's product marketing manager, the NSC800 family offers the designer highly integrated, minimum chip-count systems that satisfy low-end as well as mid-range applications. For example, says Wagner-Korne, a minimum three-chip system using the NSC800, 810 and 830 requires no external components for interfacing and incorporates 2K bytes of ROM, 128 bytes of RAM, two timer/counters, five interrupts and 32 I/O lines. This minimum system dissipates only 100 milliwatts.

"Systems operated by battery power or requiring battery back-up are natural candidates for NSC800 family implementation," says Wagner-Korne. "Similarly, systems that must operate in rugged electrical environments benefit from the broader voltage tolerances and extended temperature ranges."

All devices in the NSC800 family operate from a single power supply with a range from 3-12 volts. This permits the use of a loosely regulated power supply, resulting in a lower cost per watt. When combined with total power consumption, system power supply costs are significantly reduced. Additional savings can be realized because lower power consumption results in lower heat generation, which minimizes and sometimes eliminates the need for high heat dissipation. This allows increased component density, reducing package size. Lower heat dissipation and fewer parts provide increased systems reliability. All these advantages are possible with the NSC800 family—at no loss in performance when compared to NMOS processors.

The NSC800 family is fabricated with a new process called double poly CMOS, or P^2CMOS. For the first time, a microprocessor family has been developed that combines the high density and high performance of state-of-the-art n-channel MOS with the low power and excellent noise immunity of standard complementary MOS techniques. Although it is a new process, the individual steps in the process have been done before in one form or another. In fact, everything that has been learned about increasing density and improving performance with present NMOS technology has been used to enhance the performance.

P^2CMOS is a silicon gate process that uses oxide isolation, as opposed to diffusion isolation. It also has two levels of polysilicon interconnects, hence the name. These two levels of interconnect result in a substantial increase in density over standard CMOS, and compares well to present non-scaled NMOS processes. The method uses fairly conservative geometries—five micron lines and spaces—although the process is capable of much more. This geometry was chosen to ensure the technology is a viable, producible process in its first iteration. It also uses electron beam masks and is manufactured using 4-in. wafers.

When applied to microprocessor architectures, P^2CMOS results in significant performance improvement. For example, a register-to-register instruction time for a CMOS processor using 1977 state-of-the-art techniques lies between 3 and 5 μs. Using P^2CMOS greatly improved speeds in low power microprocessors are possible.

Used in the NSC800, for example, it makes possible a standard instruction execution time of 1.6 μs. In a speed selected version, the NSC800A, 1 Ms execution times are the norm (specifications at 5 volts for comparison purposes). The NSC800's satisfactory performance is achieved with relatively loose five micron design rules. A shrink to 3 or 3½ micron geometries will result in even further improvements.

The NSC800 CPU incorporates an 8-bit data bus and 16-bit address bus capable of directly addressing 65,536 bytes of memory plus 256 locations in separate I/O memory space. Internally, the 8-bit bus is used for communications between the register array, the arith-

Continued on page 142

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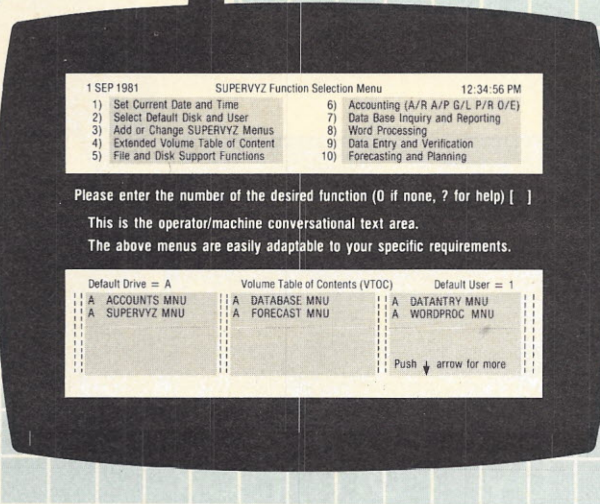

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CIRCLE INQUIRY NO. 37

Business Systems for '82

by Tom Fox

We'll admit it: we were wrong. We thought it inevitable that the combination of an uncertain world economy and the maturing throes of a fledgling industry would result in a shaking out of microcomputer manufacturers by this time.

It's happened before: the rush to enter a new high-technology marketplace is followed shortly by a brutal decimation of the players. Remarkably, the micro industry is either not to that point yet, or has survived it in grand style. For with each passing day, there seem to be more and more entrants to the wild, freewheeling small business computer fray. Companies we've never heard of—and ones that are household names in other industries—are popping up at an amazing rate.

The situation is ultimately a good one for computer buyers. More manufacturers mean a wider selection of products, and the promise that vendors will try just a bit harder to satisfy our needs. But the game is becoming mighty confusing for the professional purchaser, and next to impossible for the newcomer. You need a program to tell who the players are in this free-for-all.

And that's what the accompanying charts are intended to be: a concise guide to the business-class microcomputers now competing for your purchasing dollar. The charts hold the facts, as provided to us by the manufacturers themselves. What follows is *our* impression of the selections being offered this winter.

Alpha Microsystems. Born almost five years ago as a hobby manufacturer, this company has grown to be one of the most recognized of the "supermicro" manufacturers. The WD16 16-bit microprocessor chip is responsible for much of this, as is a proprietary multi-user operating system that borrows from the world of minicomputer-class machinery. Disk drive capacities range up to the generous, with 100 + M byte installations not uncommon. The newer Winchester hard disk offerings are placed closer in price to the 8-bit competition outlined below. Alpha computers have always been delivered with complete systems software as standard —and that includes three languages, a word processor and a host of programmer-friendly utilities. Business software is also available, but at extra cost.

Altos. The Altos catalog lists 15 distinct models of microcomputer systems, along with a clutch of upgrade kits and add-on peripherals and software products. All computers are similar in that they are based on the 8-bit Z80A microprocessor device. The 8000-2 is the basic model, consisting of the processor, 64K bytes of RAM and a pair of single sided, double density floppy diskette drives holding up to 1M byte of data. It comes with the single-user CP/M operating system, with multi-user MP/M and Oasis listed as options. Other models offer more memory (up to 208K bytes) and the capability to connect up to four terminals simultaneously. Winchester hard disk storage is available up to 40M bytes, with backup provisions on floppy disk or data cassette tape cartridge.

AM Jacquard. This company has made it's name in mail room equipment and typesetting machines for the printing industry. It is the latter product that has grown into a general-purpose microcomputer with a host of available business programs. The J100 system utilizes the rare 16-bit IMP16 chip, which can handle up to ½M byte of RAM and a bunch of background tasks. The operating system is a proprietary product of the company.

Apple. A giant in the industry with its diminutive product, Apple is perhaps the most visible of the genre. The Apple II, with us for many years, remains the sales leader of the line. Thought by many to be an unlikely vehicle for serious business processing, the extensive amount of applications software added over the years has turned the system into a fixture in many of today's offices. The newer Apple III, with its greater memory capability, built-in floppy diskette drive and more sophisticated operating system promises even greater utilization. Much of Apple's success is due to the synergistic addition of products from outside sources: Winchester disk drives, special interfacing hardware and breakthrough programs like VisiCalc. We expect the trend to continue.

Applied Digital Data Systems. ADD's Multivision line epitomizes the "grow with me" approach to microcomputer purchasing. The Multivision 1 is a single-user floppy disk based system utilizing the 8-bit 8085 CPU. The Multivision 2 adds a 10M byte Winchester disk; the Multivision 3, the hardware and software bits needed to support up to four users simultaneously. All are contained within neat stacking modules; the largest system takes no more desk space than the smallest one.

Archives. The company's latest product, the Archives-II, is completely built into a terminal-like housing. Internally, it sports S-100 cards and the popular Z80-with-CP/M hardware/software combination. A very IBM-like detachable keyboard is featured, along with a crisp green phosphor screen capable of displaying graphics, such as trend charts and bar graphs.

Astrocom. This Minnesota-based company produces the S-760, a Z80-based microcomputer featuring a long list of business software packages. Coming standard with 64K bytes of RAM, the system can be expanded up to 192K bytes, enough to serve up to five users simultaneously. A pairing of floppy and Winchester hard disks (up to 20M bytes in size) takes care of the data storage needs.

Basic Four. This company, a founding father in the small business computer arena, has recently introduced its smallest system, the S80. The S80 is a Z80-based computer including a 2M byte Winchester disk drive with floppy diskette backup. Basic Four's Business Basic has been widely copied by others, since years of use have gifted the world with thousands upon thousands of business applications programs running in this language.

California Computer Systems. Originally an S-100 board manufacturer, CCS has been doing well with its recent line of large microcomputer systems. Beginning with a floppy disk-only system, these can be expanded into multi-user machines with up to 40M bytes of storage on Winchester disk drives. The standard single-user operating system is CP/M, with multi-user MP/M and Oasis listed as options. The company has paid attention to the aesthetics of computing as well, as all of its computers can be built into attractive desk modules.

Codata. This company's products are all based upon Intel's Multibus hardware system. Depending upon the model selected, one of three different microprocessors is used. The 8-bit entry is the Z80A, with the 16-bit side represented by the Z8001 and 68000 chips. Whereas the smaller system is limited to the single-user CP/M environment, the larger computers are supplied with Xenix, a verison of Bell Laboratories' multi-user Unix operating system.

Columbia Data Products. Based near the U.S. capital, this prolific manufacturer is a specialist in multi-Z80A microprocessor computer systems. The internal architecture of the company's computers tends to be unconventional; with the result that the processing load is distributed so that it seems as if a much larger CPU were doing the work. Models range from a built-in terminal desktop model to a 16-user multiprocessing system with up to 20M bytes of hard disk storage.

Systems of Past Months

Many of the computer systems listed in the tables —and a few that are not—have undergone the scrutiny of our regular *System of the Month* or *Assignment: Benchmark* treatments. For a full evaluation of these products, pick up a back issue of *Interface Age*.

ADDS Multivision	Sep 81
Alpha Microsystems AM-100	Oct 79
Alpha Microsystems AM-1011	Jan 82
Apple II Plus	Oct 81
Cado CAT	Sep 80
Commodore CBM	Jul 81
Convergent Technologies CT 2100	Jun 81
Cromemco System Two	Feb 81
Cromemco System Three	Nov 79
DECstation 78	May 81
Digital Microsystems DSC-2	Nov 81
Digital Microsystems HEX-29	Jan 80
Heath WH89/Zenith Z89	Aug 80
Hewlett-Packard HP 83A	May 81
Hewlett-Packard HP125	Dec 81
IBM 5120	Jan 81
Industrial Micro Systems 8000	Dec 79
Lazor Systems	Jun 80
MicroDaSys Millie	Jul 80
North Star Horizon	Jan 81
Ohio Scientific C3A and C3B	Dec 81
Ohio Scientific C3C	Apr 80
Osborne 1	Nov 81
Pertec PCC 2000	Aug/Sep 79
Pertec PCC 2000	Jun 81
PolyMorphic TwinSystem 88	Oct 80
Qantel 110	Dec 80
Radio Shack TRS-80 model II	Sep 81
Rexon RX30	Mar 80
Rockwell AIM65	Nov 80
Systems Group System 2800	Oct 81
TEI System 48	Aug 81
TI 771	Mar 81
TI TM990/189	Mar 81
Technico SS16	Feb 80
Vector Graphic System B	Apr 81
Western Digital Pascal Microengine	Feb 81

Commodore Business Machines. A toy grown up —that's a description that might apply to all business microcomputers, but it has particular meaning for Commodore owners. From their beginnings as Pets, modern Commodore CBMs evidence many of the features that are so important in the business world: 80-column wide screens, floppy diskette drives and sophisticated software, such as the multi-talented VisiCalc. Disk capacities are available up to 2.1M bytes, with RAM numbers up to 96K bytes. All models feature built-in terminals with graphic capabilities.

Compal. Begun as a Los Angeles area computer store with the intriguing shingle of Computer Power & Light Co., this company has made the jump into a full-fledged computer assembler. The company concentrates on turnkey systems—those that don't demand engineering or programming talents of the user. The machines are assembled with Z80 micros on S-100 busses, and work only in single-user environments. Floppy disk systems are featured, along with a 5M byte Winchester option.

COMX. This company is a division of an established Hong Kong manufacturing and distributing operation. Its first computer product is the DL-1, based on the 8-bit 6809 microprocessor device. Both floppy diskette and Winchester hard disk drives are offered. Software includes both single- and multi-user operating systems.

Cromemco. A pioneer in the S-100 hobby computer marketplace, this company has survived to become one of the leaders in small business computing. Unlike many of its competitors, Cromemco maintains a strong in-house software staff to support a very CP/M-like operating system for single user systems; as well as a Cromix, an offspring of multi-user Unix. System One, the newest computer, is a newly-packaged version of the larger System Three. It features RAM sizes up to 320K bytes, multi-user operation and standard floppy disk drives. Winchester-technology hard disk drives and a good selection of terminals and printers are available as options.

Digilog. This is an all-in-one desktop computer that goes beyond the floppy-in-a-terminal idea promoted by so many. The System 1500 contains both a 0.7M byte floppy diskette and 5M byte Winchester disk drive snuggled together with display screen, keyboard and complete computer. The processor is a Z80A; the operating system, CP/M.

Digital Microsystems. This engineering and systems-oriented micro and minicomputer manufacturer has been in the forefront of microprocessor technology for over a decade. With thousands of systems installed worldwide, DMS is recognized as a technical leader in the computer industry. DMS systems are noted for their advanced engineering designs and high level reliability.

Distributed Computing Systems. This company is a specialist in industrial computer devices, particularly those utilizing the versatile Multibus. Its most complete computer systems are the DCS/8, an 8-bit 8080-based computer; and the DCS/86, featuring the 16-bit 8086 chip. Both are floppy disk based machines with hard disk options. Although intended primarily for industrial control and product development chores, these computers are also able to handle general business tasks.

Dynabyte. Another San Francisco bay dweller, this company settled on the S-100 bus early in life and has stayed with that design even with its modern business computers. A striking appearance has always set these products apart, and that's true of the newer Winchester

disk based systems as well. Up to 45M bytes of data can be stored on these hard disk surfaces. Single- and multi-user applications are supported via CP/M, enhanced MP/M and Oasis.

Exidy. Originally makers of Sorcerers, this company now builds computers with names like Efficiency, System 80 and Multi-net 80. The changes signify a leaning towards the business use of its small computers. Multi-user systems are now offered, as well as those with up to 360M bytes of hard disk storage capacity. Exidy computers have always been S-100 bus compatible, with fine, eye-pleasing definition on their graphics-capable display screens.

Findex. These computers have all the appearance of being no more than a portable terminal, with keyboard, hard-copy printer and acoustically-coupled modem built in. In actuality, the machines are tiny, full-capability computer systems that just happen to be transportable. The units are set apart by two advanced-technology

The game is confusing for the professional purchaser. . .almost impossible for the newcomer

tricks: a flat, orange gas plasma panel instead of the normal CRT display screen, and up to 2M bytes of bubble memory inside. Floppy diskette drives are available as well, as is an S-100 bus adapter.

Gnat. A computer with the unlikely name of Gnat is an all-in-one machine that surrounds keyboard, terminal, floppy disk drives and all computing electronic components in a single package. Upgradable versions of the System 10 are available with hard disks to 10M bytes.

Hewlett-Packard. This highly-regarded manufacturer of electronic instrumentation and pocket calculators offers two distinctively different microcomputer systems. The smallest is the HP 85, a desktop computer intended for the scientist or professional—although its software catalog would suggest a more business-oriented bent. The newer HP 125 is somewhat larger, and makes headlines with its adoption of the CP/M operating system, Microsoft Basic language and enhanced VisiCalc financial planning program. The HP 125 is a desktop machine too, and works with a pair of Z80As and the components of a very smart terminal from the mega-minicomputer class HP 3000 lineup.

IMS International. Until recently called Industrial Micro Systems, this company is another of those that entered the computer business as a manufacturer of S-100 boards and accessories. Its computer systems are Z80-based, comfortably housed in robust IMS-fabricated desks and enclosures. A wide selection of

independently supplied software is available, from the CP/M operating system through multi-user versions and a host of languages and business applications programs.

Integrated Business Computers. Cadet and Ensign are the jaunty names for two offerings from this computer manufacturer. Both are driven with the Z80A microprocessor device, and both claim a familiarity with the popular CP/M and Oasis operating systems. The Cadet comes with 64K bytes of user memory and 2M bytes of on-line floppy disk capacity. The larger Ensign can be fitted with up to 768K bytes of memory in the multi-user configuration, and boasts hard disk capacities from 14 to 17M bytes.

International Business Machines. Introduced amidst some justified trembling by the competition last fall, the IBM personal computer is clearly in a class with many of the smaller business systems shown in our charts. A 16-bit CPU running under the CP/M operating system is a powerful force, and we can expect to see others following IBM'S path. Hobbled with a floppy disk of only modest size, the computer is able to handle a generous ¼M byte of user memory. In the software area, IBM has borrowed heavily from the industry it is wooing. Names like VisiCalc, Microsoft and Peachtree give the personal computer a familiar touch, one intended to boost IBM sales in a previously unapproached market.

Intertec. With catchy names like SuperBrain and CompuStar, this company's products command a lot of attention. The SuperBrain is an all-in-one desktop computer with built-in floppy diskette drives. The CompuStar is a medusa network of SuperBrain-like machines that communicate together via a distributed processing network. Up to 255 terminals can be interlinked with this plan. The CP/M operating system is used, so a lot of available applications programs will run on these machines.

Ithaca InterSystems. This New York-based computer manufacturer is heavily into Pascal machines, both for developing applications programs and the heavier task of writing systems software. The secret, as evidenced in the top-of-the-line DPS-8000, is a fast Pascal compiler that makes the most of a 16-bit Z8002 processor chip. Smaller machines run Pascal/Z on 8-bit Z80 micros. Some of the InterSystems computers have a rather old-fashioned look with their panel full of paddle switches and flashing lights. We almost wish the industry were not so anxious to rid itself of these useful diagnostic tools.

Lazor. Here's a company that is combining a powerful 16-bit microprocessor with a thoroughly thought-out applications program to attack what the industry has been calling the "vertical marketplace." The package is called the Retailer. Its intent is to handle all of the inventory control and money-tracking chores that might be found in an automobile parts store or other similar business. Interfacing with electronic cash registers is standard. The Retailer will run on any of three sizes of Lazor computers, ranging from a floppy disk equipped machine to a system boasting up to 32M bytes of data storage.

Logical Machine. David, Tina and Goliath are the names of Logical Machines, the Old Testament notwithstanding. Each features a 16-bit microprocessor and modest collection of floppy diskette drives. Goliath, as you would expect, tops the line with nearly 100M bytes of hard disk storage. The trio shares an

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acquaintance with English, a powerful data base program designed to solve business users' problems in something approaching their native tongue.

MCM Computers. One of the few Canadian micro makers, this company offers two classes of machinery. One utilizes the familiar pairing of Z80 microprocessor and S-100 bus, along with CP/M for the operating system. Other models combine a duet of 2901 bit-slice chips into a super-fast 8-bit processor. The operating system is necessarily the company's own, as the factory invented its own machine-language instruction set as a part of the development process. Data storage is available in the range of 1M byte of floppy diskettes to 28M bytes of Winchester-technology hard disks.

MDM Systems. A division of Mohawk Data Sciences, this New Jersey based company began life as a manufacturer of data communications products. Its smallest current offering is the series 21, a single-station computer with built-in terminal and floppy diskette drive. The computer is unusual in that it boasts a large 15-in. (diagonal measure) display screen. The series 21 will run Cobol or proprietary MOBOL programs that have been compiled on a larger MDS computer.

Mercator. Multi-user systems are all that this company builds—up to eight terminals in size. The processor that handles all of this is the 8086 16-bit device, which is finding its way into so many of today's newest business computers. The only available language is Mercator's Business Basic, said to be compatible with the Basic Four's version. Configurations are available with up to 240M bytes of storage space for data.

Micro Five. This Southern California company began life as a maker of single-board 8-bit 8085 microcomputers. It has since graduated into the 16-bit world with a pair of 8086-powered systems designed specifically for business use. All systems utilize a proprietary multi-user operating system and extended Basic language. A selection of general business programs is available, as is a parts distribution vertical market package. The series 3000 is the newest Micro Five product; it's a neat package containing 10M byte Winchester and floppy disk drives in a single tabletop shell.

Micromation. Micromation's Mariner microcomputer is housed in a distinctive, slim floor-standing cabinet that houses a Z80A CPU, 64K bytes of memory and a pairing of floppy and Winchester disk drives. Internally, the hardware utilizes the S-100 bus. Significantly, up to eight terminals can be connected to the system using a multiprocessor scheme. The catalog lists no applications software, but a CP/M compatibility goes a long way towards solving that problem.

North Star. With us since the early days of microcomputing, North Star has evolved to become one of the most popular of small business computers. An installed base of some 28,000 machines has helped materially in spreading the S-100 idea far and wide. The NSDOS operating system is in the mold of CP/M, and many business applications programs are available in both formats. This company has kept up with the current trend for massive storage capability, offering systems with Winchester disk capacities up to 18M bytes.

Osborne. Who hasn't heard of the Osborne 1? Introduced with a flourish of publicity last summer, examples of this tiny computer are now finding their ways into the users' hands in quantity. Remarkable because of its portability and astonishingly low price, the system includes as standard much of the most popular of microcomputer software: CP/M, WordStar, Microsoft Basic and CBasic, as well as SuperCalc, one of the newest of the VisiClone set. Critics of the Osborne design are quick to point out items that are unavoidable compromises necessary to ensure portability: a tiny display screen of non-standard dimensions and the (comparatively) limited capacity of the pair of built-in minifloppy diskette drives.

PolyMorphic. This company is another "old timer" in the S-100 microcomputer world. Although sticking with the rather dated 8-bit 8080 CPU chip, the new designs sport massive Winchester disk drives (up to 280M bytes) and a full catalog of applications software. The operating system is the company's own, but CP/M is listed as an option on all models.

Prodigy. Here's a Z80A-based system that is built into a neat desk, intended solely for small business environments. The company's most unique contribution is its Protege systems software. It's a combination data base manager and Cobol-styled programming language. Applications programs are compiled (rather than interpreted), so they will run fast in their end use. Many already-written business applications are offered by the manufacturer.

Radio Shack. It seems but a short time ago that the idea of a computer from Radio Shack sounded like a joke. With a population that now exceeds the combined totals of all other competitors, the TRS-80 has surely had the last laugh. The company's most sophisticated offering is the model II, a strictly business machine built around the Z80A microprocessor. Dual floppy diskettes hold the data. The unit has a built-in terminal, and is

limited to single-user situations. The model III has taken up the discontinued model I's position as the company's entry level business computer. It is the first of the clan to offer a Winchester-technology hard disk drive as an option.

Rexon. The Rexon RX-series of computers was designed with a single-minded goal: serious business computing. You won't find any "toy" 8-bit microprocessors in the machinery; nor any "sissy" floppy disks, either. Engined by the powerful 16-bit 8086 CPU, the machines can handle either four or eight users simultaneously, and hold their data on minicomputer-class removable cartridge disk drives—up to 40M bytes in some cases. The Basic language used is quite compatible with Basic Four's version. It was a deliberate choice, making Rexon equipment a fitting modern host for some thousands of Basic Four applications programs scattered about the world.

Scientific Data Systems. Although the name says "scientific," the computer products of this firm shout "business." The systems feature fully integrated packages for accounts payable and receivable, payroll and a grouping of special interest packages: medical and legal billing and a Westlaw-certified attorney's package. The hardware utilizes the 6502A 8-bit microprocessor (shared with Apple and Commodore products). Both floppy diskette and Winchester hard disk systems are available.

Smoke Signal Broadcasting. Originally a contender to the S-100 bus, the SS-50 bus has faded into undeserved relative obscurity in recent times. This company has remained one of the last prompters of this architecture, which is based on the 6800 and advanced 6809 8-bit microprocessor chips. Convinced that its path is the best (if not the most followed) one, the company continues to introduce impressive enhancements to its Chieftan line of business computers. These machines are now available with single- and multi-user operating systems, almost every programming language and a full portfolio of business applications programs.

Symcro. Lurking within a squat floor-standing cube is a buzzing nest of up to 24 Z80 microprocessors, along with supporting user memory, totaling an incredible 10M bytes. It's a multi-processor designed computer system that is built around a proprietary 50-pin inter-CPU bus. The operating system is the company's own, but is CP/M compatible. Each of 24 users can have his own printer, if desired. Disk storage is offered up to 300M bytes on a combination of Winchester drives.

Systems Group. Long a maker of S-100 computer, memory and interfacing boards, this company recently graduated to become computer system manufacturer with its system 2800. It's an advanced Z80A machine that comforms to the new IEEE S-100 bus standard, and is available with CP/M or an enhanced version of multi-user MP/M. Versions are available with floppy and/or Winchester hard disk drives, and user memory configurations up to ½M byte in capacity. Hardware constructed by the company is available to connect up to 12 terminals and/or printers to each system.

TEI. The newest trick from this computer manufacturer is a multi-processing giant called the system 48. Each of the 16 users can command the full attention of a dedicated 8085 8-bit CPU, with one left over to manage the system's disk drives. 20M bytes of Winchester storage are standard, with growth offered to eight times that amount. The operating system is the company's own, but is compatible with CP/M programs written by others. It incorporates an integral data base management system for efficiency. In addition, the company manufactures a line of single-user S-100 bus computers featuring integrated floppy diskette drives.

TeleVideo. Experts at creating low-cost, full capability CRT terminals, this company is a newcomer to the computer systems arena. There are three products, graduated in increasing size and complexity. The TS 801 is a single-user system featuring a 1M-byte minifloppy diskette drive; the TS 806, a six-user machine with a 10M-byte Winchester drive; and the TS 816, a 16-user monster with up to 70M bytes of storage. All feature CP/M, and all use the Z80A CPU—with the multi-user versions carrying several of them in a distributed multiprocessing arrangement. The computers are delivered with one or more of TeleVideo's top-of-the-line TV-920 smart terminals.

TSC. This company is representative of the many systems houses that make their living by transforming Digital Equipment Corporation's LSI-11 16-bit microprocessor hardware into complete computer systems. The configuration chosen for the BC 2308 is a 128K-byte machine with 20M bytes of Winchester disk and a data-quality cassette tape backup. Systems software is from DEC, and applications programming is left up to the purchaser of the BC 2308.

Vector Graphic. This company, another early entry into the S-100 scene, has always stood apart with its dedication to memory-mapped display screens. These can operate several times as fast as ordinary CRTs, but the scheme elicits a modest penalty in memory space. The speed is put to good use with the company's popular proprietary word processing package. A large array of computer systems is offered, from compact minifloppy-equipped single-user machines to a five-user machine with 5M bytes of Winchester disk storage capacity. The computers are CP/M-based, opening the door to lots of independent applications programs.

Zeda. From the Rocky Mountain country near Provo, UT come the Zeda computer systems. They are Z80A-engined and run on a proprietary bus that accesses 64K bytes of user memory. A mix of floppy and/or Winchester hard disk drives is available. The operating system is a Zeda superset of CP/M, and features a doorway into a multi-computer network called InfiNet.

Zenith. One of the most valuable assets acquired by this company when it purchased the Heath Co. was the H-89 desktop computer. Now marketed as the identical Z-89, the system has proven itself to be just the right size for many small businesses. The single 102K byte minifloppy diskette drive can now be augmented with external drives, and even a new 10M-byte Winchester unit. Twin Z80s provide the processing horsepower. Both Heath's HDOS and the CP/M operating systems are available, supported by two versions of Basic, including the popular Microsoft incarnation. New on the market is the Z-90 computer, a Z-89 with a full 64K bytes of RAM and double the storage capacity on its single diskette drive. □

Charts follow

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Table 1. Hardware Data

MANUFACTURER	SYSTEM	PRICE	ENCLOSURE			CPU		BUS	PERIPHERALS	
			Tabletop	Desk	Rack	Type	Bits		Terminal Std/Max	Printer Std/Max
ADDS	Multivision 1	$ 3,758	Std	None	None	8085	8	Prop	None/1	None/1
	Multivision 2	$ 8,595	Std	None	None	8085	8	Prop	None/1	None/1
	Multivision 3	$13,595	Std	None	None	8085	8	Prop	None/4	None/1
Alpha Micro	AM-1021	$14,000	Std	None	Opt	WD16	16	S-100	None/14	None/13
	AM-1041	$17,000	Std	None	Opt	WD16	16	S-100	None/24	None/23
Altos Computer	8000-2	$ 3,650	Std	Opt	Opt	Z80	8	Prop	None/4	None/2
	8000-15	$ 4,990	Std	Opt	Opt	Z80	8	Prop	None/4	None/2
	8000-10	$ 8,500	Std	Opt	Opt	Z80	8	Prop	None/4	None/2
AM Jacquard Systems	J100	$20,000	Std	Opt	Opt	IMP16	16	Prop	1/11	1/8
Apple	Apple II	$ 2,495	Std	None	None	6502	8	Prop	1/1	None/1
	Apple III	$ 3,495	Std	None	None	6502C	8	Prop	1/1	None/1
Archives Inc.	Archives-I	$ 6,500	Std	None	None	Z80	8	S-100	1/1	None/1
	Archives-II	$ 7,500	Std	None	None	Z80	8	S-100	1/1	None/1
	Archives-III	$ 8,500	Std	None	None	Z80	8	S-100	1/1	None/1
Astrocom Corporation	S-760	$15,000	None	Std	None	Z80	8	Prop	1/5	1/5
Basic Four	S80	$15,990	None	None	Std	Z80	8	ICOM	1/4	1/6
California Computer Systems	CCS 300	$ 5,695	Std	Opt	Opt	Z80	8	S-100	None/16	None/2
	CCS 400	$ 8,225	Std	Opt	Opt	Z80	8	S-100	None/16	None/2
	CCS 410	$10,100	Std	Opt	Opt	Z80	8	S-100	None/16	None/2
Codata Systems Corporation	CTS-100/6	$ 9,937	Std	None	None	Z80	8	Multibus	1/1	None/1
	CTS-200/6	$13,950	Std	None	None	Z8001	16	Multibus	1/8	None/7
	CTS-300/6	$19,500	Std	None	None	68000	16	Multibus	1/10	None/9
Columbia Data Products	DC-100-8	$18,640	Std	Opt	Opt	Z80A	8	Prop	None/16	None/2
	1811-20	$ 8,995	Std	Opt	Opt	Z80A	8	Prop	None/5	None/2
	964-20	$ 4,995	Std	None	Opt	Z80A	8	Prop	1/1	None/2
Commodore	CBM 8032	$ 1,495	Std	None	None	6502	8	Prop	1/1	None/1
	CBM 4032	$ 1,295	Std	None	None	6502	8	Prop	1/1	None/1
	CBM 4016	$ 995	Std	None	None	6502	8	Prop	1/1	None/1
Compal	Compal 8200	$12,500	None	Std	None	Z80	8	S-100	1/1	1/4
	Compal EzType	$ 8,995	Std	Opt	None	Z80	8	S-100	1/1	1/4
COMX World Operations Ltd.	DL-1	$ 7,800	Std	None	Opt	6809	8	Prop	None/16	None/2
Cromemco	System One	$ 3,995	Std	None	Opt	Z80A	8	S-100	None/3	None/2
	System Three	$ 7,995	None	Opt	Std	Z80A	8	S-100	None/7	None/3
	Z-2H Hard Disk	$ 9,995	None	Opt	Std	Z80A	8	S-100	None/7	None/3
Digilog Business Systems	System 1000	$ 4,995	Std	None	None	Z80A	8	n/a	1/1	None/1
	System 1500	$ 8,795	Std	None	None	Z80A	8	n/a	1/1	None/1
Digital Microsystems	HiNet DSC-3/101	$ 8,995	Std	None	None	Z80A	8	None	None	None
	DSC-4	$ 6,995	Std	None	None	Z80A	8	Multibus	None	None
Distributed Computer Systems	DCS/80	$ 4,895	Std	Opt	Std	8080	8	Multibus	None/2	None/1
	DCS/86	$ 6,995	Std	Opt	Std	8086	16	Multibus	None/3	None/1
Dynabyte	5505	$ 6,995	Std	Opt	None	Z80	8	S-100	None/8	None/16
	5700	$12,995	Opt	Std	None	Z80	8	S-100	None/8	None/16
Exidy Systems Inc.	Efficiency	$ 2,995	Std	None	None	Z80	8	S-100	1/1	None/1
	System 80	$ 4,490	Std	None	None	Z80	8	S-100	1/1	None/1
	Multi-Net 80	$17,480	Std	Opt	Opt	Z80A	8	S-100	1/16	None/16
Findex	234	$ 6,980	Std	None	None	Z80	8	S-100	1/1	1/1
	105	$ 7,000	Std	Opt	Opt	Z80	8	S-100	1/1	1/1
Gnat Computers, Inc.	10	$ 5,950	Std	None	None	Z80A	8	None	1/1	None
	10M	$ 6,950	Std	None	None	Z80A	8	None	1/1	None
	10H	$ 8,350	Std	None	None	Z80A	8	None	1/1	None
Hewlett-Packard	HP-85	$ 3,250	Std	Opt	None	Prop	8	Prop	1/1	1/2
	HP 125	$ 6,250	Std	Opt	None	Z80A	8	Prop	1/1	None/2
IBM	Personal Computer	$ 3,010	Std	None	None	8086	16	Prop	1/1	None/1
Integrated Business Computers	Cadet	$ 5,500	Std	Opt	Opt	Z80A	8	None	None/9	None/9
	Ensign	$10,000	None	Std	Opt	Z80B	8	None	None/16	None/16
IMS International	5000 SX	$ 3,695	Std	Opt	None	Z80	8	S-100	None/2	None/1
	8000	$ 5,295	Std	Opt	Opt	Z80	8	S-100	None/2	None/1
Intertec Data Systems	SuperBrain	$ 3,495	Std	None	None	Z80A	8	Prop	1/1	None/1
	SuperBrain QD	$ 3,995	Std	None	None	Z80A	8	Prop	1/1	None/1
	Compustar Model 10	$ 2,495	Std	None	None	Z80A	8	Prop	1/255	None/n/a

n/a = information not available

None = not available from manufacturers; in many cases available through outside sources

Table 1. Hardware Data (continued)

MANUFACTURER	SYSTEM	PRICE	ENCLOSURE			CPU		BUS	PERIPHERALS	
			Tabletop	Desk	Rack	Type	Bits		Terminal Std/Max	Printer Std/Max
Ithaca Intersystems, Inc.	CB-128 SFPL	$ 6,995	Std	None	Opt	Z80	8	S-100	None/1	None
	PDS-80 SFPL	$ 7,295	Std	None	Opt	Z80	8	S-100	None/1	None
	DPS-8000	$20,000	Std	None	Opt	Z8002	16	S-100	None/8	None/2
Lazor Systems	Lazor 5	$13,665	Std	None	None	8086	16	Prop	None/16	None/4
	Lazor 30	$20,335	None	Std	None	8086	16	Prop	None/16	None/4
	Lazor 80	$27,500	None	Std	None	8086	16	Prop	None/16	None/4
Logical Machine Corporation	David	$ 8,500	Std	None	None	8086	16	Prop	None/1	1/1
	Tina	$15,000	Std	None	None	3002	16	Prop	None/1	1/1
	Goliath	$33,325	None	None	Std	8086	16	Prop	1/20	1/20
MCM Computers	ABS 1500	$14,800	Std	None	None	Z80	8	S-100	None	None/1
	Micropower	$12,700	Std	None	None	2901	8	Prop	None	None/1
	Power	$20,100	Std	None	None	2901	8	Prop	1/8	None/4
Mercator	MBS3110	$19,900	Std	None	Opt	8086	16	Prop	1/4	1/3
	MBS4111	$30,500	Std	None	Opt	8086	16	Prop	1/8	1/7
Micro Five Corporation	Microstar I	$ 8,500	Std	None	Opt	8085A	8	Prop	1/2	None/1
	Microstar II	$12,000	Std	None	Opt	8086	16	Prop	1/4	None/1
	Series 3000	$18,000	Std	None	Opt	8086	16	Prop	1/10	None/1
Micromation	Mariner	$ 5,950	None	None	Std	Z80A	8	S-100	None/8	None/n/a
	M/System	$ 5,500	None	None	Std	Z80A	8	S-100	None/8	None/n/a
Mohawk Data Sciences	System 21/10	$ 7,035	Std	None	None	Prop	8	Prop	1/1	None/1
	MDS Series 21	$ 7,900	None	Std	None	Prop	8	Prop	1/4	None/4
North Star Computer	Horizon	$ 4,495	Std	None	None	Z80A	8	S-100	None/5	None/5
	Advantage	$ 3,999	Std	None	None	Z80A	8	Prop	None	None/5
Osborne Computer Corporation	Osborne 1	$ 1,795	Std	None	None	Z80A	8	Prop	1/1	None/1
PolyMorphic Systems	System 8813	$ 5,595	Std	Opt	Opt	8080	8	S-100	None/2	None/2
	System 8810	$ 3,595	Std	None	None	8080	8	S-100	None/1	None/1
	System 88/HD	$11,495	Std	Opt	Opt	8080	8	S-100	None/2	None/2
Prodigy Systems, Inc.	Prodigy I	$ 9,995	None	Std	None	Z80A	8	None	1/2	None/1
Radio Shack	TRS-80 Model III	$ 2,495	Std	None	None	Z80A	8	Prop	1/1	None/1
	TRS-80 Model II	$ 3,899	Std	None	None	Z80A	8	Prop	1/1	None/1
Rexon	RX15	$19,700	Std	None	None	8086	16	Prop	1/4	1/1
	RX20-2	$26,850	None	None	Std	8086	16	Prop	2/8	1/1
	RX30-2	$38,100	None	None	Std	8086	16	Prop	4/8	1/1
Scientific Data Systems	SDS 420	$ 8,400	Std	None	None	6502A	8	Prop	None/255	None/255
	SDS 423	$10,900	Std	None	None	6502A	8	Prop	None/255	None/255
	SDS 432	$18,400	Std	None	None	6502A	8	Prop	None/255	None/255
Smoke Signal Broadcasting	Chieftain 9822	$ 5,870	Std	Opt	Opt	6809	8	SS-50	1/16	1/16
	Chieftain 98W10	$ 9,890	Std	Opt	Opt	6809	8	SS-50	1/16	1/16
	Chieftain 98W30	$12,990	Std	Opt	Opt	6809	8	SS-50	1/16	1/16
Symcro Systems, Inc.	SB700	$24,975	None	None	Std	Z80	8	Prop	2/24	1/24
Systems Group	2812	$ 5,035	Std	None	Opt	Z80A	8	S-100	None/12	None/1
	2829	$ 9,995	Std	None	Opt	Z80A	8	S-100	None/12	None/1
	2842	$12,500	Std	None	Opt	Z80A	8	S-100	None/12	None/1
TEI	3452	$ 3,295	Std	None	None	8085	8	S-100	None/1	None/2
	3482	$ 5,395	Std	None	None	8085	8	S-100	None/1	None/2
	System/48	$24,230	None	None	Std	8085	8	Prop	1/16	1/16
Televideo	TS801	$ 3,995	Std	None	None	Z80A	8	None	1/1	None/1
	TS806	$ 8,995	Std	None	None	Z80A	8	None	1/6	None/8
	TS816	$19,995	Std	None	None	Z80A	8	None	2/16	None/18
TSC	BC2308	$24,000	Std	Opt	Opt	LSI-11	16	DEC Q	None/8	None
Vector Graphic, Inc.	2600	$ 5,195	Std	Opt	None	Z80A	8	S-100	1/1	None/1
	3005	$ 7,950	Std	Opt	None	Z80A	8	S-100	1/1	None/1
	5005	$ 8,995	Std	Opt	None	Z80A	8	S-100	1/5	None/2
Zeda	Zeda 589	$ 5,938	Std	None	None	Z80A	8	Prop	1/2	None/2
	Zeda 582-15	$10,500	Std	None	None	Z80A	8	Prop	1/2	None/2
	Zeda 529	$ 4,095	Std	None	None	Z80A	8	Prop	1/1	None/1
Zenith Data Systems	Z-89	$ 2,895	Std	None	None	Z80	8	Prop	1/2	None/1
	Z-90	$ 3,195	Std	None	None	Z80	8	Prop	1/2	None/1

n/a = information not available

None = not available from manufacturers; in many cases available through outside sources

Table 2. Memory/Mass Storage Data

MANUFACTURER	SYSTEM	Memory (RAM) K-byte		MASS STORAGE DESCRIPTION & CAPACITY: Floppy Disk K-byte		Winchester Disk M-byte		Cartridge M-byte		Tape M-byte	
		Std	Max	Std	Max	Std	Max	Std	Max	Std	Max
ADDS	Multivision 1	64	64	700	700	None	None	None	None	None	None
	Multivision 2	64	64	700	700	10	10	None	None	None	None
	Multivision 3	128	256	700	700	10	10	None	None	None	None
Alpha Micro	AM-1021	128	512	1200	4800	8.5	128	None	360	None	20
	AM-1041	128	512	None	4800	32	128	None	360	None	20
Altos Computer	8000-2	64	64	1000	1000	None	None	None	None	None	None
	8000-15	208	208	1000	2000	None	40	None	None	None	17
	8000-10	208	208	500	500	10	40	None	None	None	17
AM Jacquard Systems	J100	128	512	500	500	None	None	None	320	None	None
Apple	Apple II	48	64	140	140	None	None	None	None	Audio	Audio
	Apple III	128	256	140	140	None	None	None	None	None	None
Archives Inc.	Archives-I	64	64	772	772	None	None	None	10	None	None
	Archives-II	64	64	1560	1560	None	None	None	10	None	None
	Archives-III	64	64	780	780	5	5	None	10	None	None
Astrocom Corporation	S-760	64	192	2000	4000	10	20	None	None	None	None
Basic Four	S80	64	64	1200	2400	2	17	None	None	None	None
California Computer Systems	CCS 300	64	512	1200	4800	None	None	None	None	None	None
	CCS 400	64	512	None	4800	10	40	None	None	None	None
	CCS 410	64	512	1200	4800	10	40	None	None	None	None
Codata Systems Corporation	CTS-100/6	64	64	380	380	6	6	None	80	None	17
	CTS-200/6	128	1000	380	380	6	6	None	80	None	17
	CTS-300/6	256	1500	380	380	6	6	None	80	None	17
Columbia Data Products	DC-100-8	64	320	1200	2400	10	20	None	None	None	None
	1811-20	256	256	1200	1200	10	20	None	None	None	None
	964-20	964	128	400	1600	None	10	None	None	None	None
Commodore	CBM 8032	32	96	None	2100	None	None	None	None	None	Audio
	CBM 4032	32	32	None	2100	None	None	None	None	None	Audio
	CBM 4016	16	32	None	2100	None	None	None	None	None	Audio
Compal	Compal 8200	56	56	630	2500	None	5	None	None	None	None
	Compal EzType	56	56	630	2500	None	5	None	None	None	None
COMX World Operations Ltd.	DL-1	57	768	n/a	n/a	None	n/a	None	None	None	None
Cromemco	System One	64	320	780	1560	None	None	None	None	None	44
	System Three	64	512	2400	4800	None	None	None	None	None	44
	Z-2H Hard Disk	64	512	780	1560	10.5	42	None	None	None	44
Digilog Business Systems	System 1000	64	64	664	664	None	None	None	None	None	None
	System 1500	64	64	700	700	5	5	None	None	None	None
Digital Microsystems	HiNet DSC-3/101	64	64	509	1000	10	23	None	None	None	20
	DSC-4	128	512	1000	2000	None	28	None	None	None	20
Distributed Computer Systems	DCS/80	64	256	500	2000	None	24	None	16	None	80
	DCS/86	64	1000	500	2000	None	24	None	16	None	80
Dynabyte	5505	64	400	1000	1000	5	16	None	None	None	None
	5700	64	400	None	None	11	45	None	None	17	17
Exidy Systems Inc.	Efficiency	48	48	308	616	None	20	None	None	None	3.6
	System 80	48	48	1200	1200	None	20	None	None	None	3.6
	Multi-Net 80	64	64	512	2048	None	360	None	None	None	20
Findex	234	80	n/a	400	800	None	None	None	10	None	None
	105	80	128	800	2400	None	20	None	None	None	None
Gnat Computers, Inc.	10	64	64	648	n/a	None	10	None	None	None	None
	10M	64	64	1600	n/a	None	10	None	None	None	None
	10H	64	64	800	n/a	5	n/a	None	None	None	None
Hewlett-Packard	HP-85	16	32	None	5000	None	None	None	None	0.21	0.21
	HP 125	64	64	500	5000	None	None	None	None	None	None
IBM	Personal Computer	64	256	160	320	None	None	None	None	None	Audio
Integrated Business Computers	Cadet	64	256	2000	4000	None	70	None	None	None	46
	Ensign	256	768	2000	4000	None	70	None	None	None	46
IMS International	5000 SX	64	320	330	495	None	11	None	384	None	17.5
	8000	64	320	512	1024	None	71	None	384	None	17.5
Intertec Data Systems	SuperBrain	64	64	350	350	None	10	None	None	None	None
	SuperBrain QD	64	64	750	750	None	10	None	None	None	None
	Compustar Model 10	64	64	None	1500	None	10	None	384	None	None

n/a = information not available

None = not available from manufacturers; in many cases available through outside sources

Table 2. Memory/Mass Storage Data (continued)

MANUFACTURER	SYSTEM	Memory (RAM) K-byte		MASS STORAGE DESCRIPTION & CAPACITY							
				Floppy Disk K-byte		Winchester Disk M-byte		Cartridge M-byte		Tape M-byte	
		Std	Max	Std	Max	Std	Max	Std	Max	Std	Max
Ithaca Intersystems, Inc.	CB-128 SFPL	128	1000	1200	4800	None	None	None	None	None	None
	PDS-80 SFPL	128	1000	1200	4800	None	None	None	None	None	None
	DPS-8000	256	16000	1200	4800	10	160	None	None	None	80
Lazor Systems	Lazor 5	128	1024	2400	2400	None	None	None	None	None	None
	Lazor 30	128	1024	1200	2400	20	20	None	None	None	20
	Lazor 80	128	1024	2400	2400	None	None	32	32	None	96
Logical Machine Corporation	David	64	64	1250	1250	None	None	None	None	None	None
	Tina	64	64	2500	2500	None	None	None	None	None	None
	Goliath	64	256	None	None	None	None	10	55	None	None
MCM Computers	ABS 1500	64	64	800	800	5	5	None	None	None	None
	Micropower	24	24	1000	4000	None	None	None	None	None	None
	Power	24	24	1200	1200	8.4	28	None	None	None	None
Mercator	MBS3110	64	512	None	None	10	80	None	None	12	12
	MBS4111	128	512	None	None	10	240	None	None	12	12
Micro Five Corporation	Microstar I	64	64	2400	2400	None	20	None	None	None	None
	Microstar II	128	384	2400	2400	None	20	None	None	None	None
	Series 3000	128	1000	1200	1200	10	54	None	None	13	13
Micromation	Mariner	64	576	1000	2000	None	21	None	None	None	20
	M/System	64	576	1000	2000	None	21	None	None	None	20
Mohawk Data Sciences	System 21/10	96	96	250	500	None	None	None	None	None	None
	MDS Series 21	64	256	500	1000	None	60	None	312	None	80
North Star Computer	Horizon	64	352	360	1600	None	18	None	None	None	None
	Advantage	64	128	720	1600	None	5	None	None	None	None
Osborne Computer Corporation	Osborne 1	64	64	204	n/a	None	None	None	None	None	None
PolyMorphic Systems	System 8813	64	104	1070	8630	None	None	None	None	None	None
	System 8810	56	56	360	1070	None	None	None	None	None	None
	System 88/HD	64	104	1260	1260	10.8	280	None	None	None	None
Prodigy Systems, Inc.	Prodigy I	64	64	512	2048	None	20	None	None	None	None
Radio Shack	TRS-80 Model III	48	48	300	670	None	None	None	None	None	1
	TRS-80 Model II	64	74	416	1874	None	16.8	None	None	None	None
Rexon	RX15	64	64	None	None	None	None	10	10	None	None
	RX20-2	64	256	None	None	None	112	10	20	None	None
	RX30-2	64	256	None	None	None	112	20	40	None	None
Scientific Data Systems	SDS 420	32	64	1250	2500	None	62	None	None	None	None
	SDS 423	64	64	2500	2500	None	62	None	None	None	None
	SDS 432	64	64	1250	2500	None	62	None	None	None	None
Smoke Signal Broadcasting	Chieftain 9822	32	1000	2000	8000	None	120	None	None	None	80
	Chieftain 98W10	32	1000	1000	8000	10	40	None	None	None	80
	Chieftain 98W30	32	1000	1000	8000	30	120	None	None	None	80
Symcro Systems, Inc.	SB700	256	10000	1000	1000	20	300	None	None	None	n/a
Systems Group	2812	64	512	1260	2500	None	40	None	None	None	None
	2829	128	512	1260	1260	10	40	None	None	None	None
	2842	128	512	None	1260	20	40	None	None	20	20
TEI	3452	64	64	494	3600	None	None	None	None	None	None
	3482	64	64	1800	3600	None	None	None	None	None	None
	System/48	128	1000	1300	2600	20	160	None	None	None	18
Televideo	TS801	64	64	1000	1000	None	None	None	None	None	None
	TS806	64	448	500	500	10	20	None	None	None	17
	TS816	64	1100	None	None	23.5	70.5	None	None	17	17
TSC	BC2308	128	256	None	None	20	n/a	None	None	20	n/a
Vector Graphic, Inc.	2600	56	56	630	1200	None	None	None	None	None	None
	3005	56	56	315	630	5	5	None	None	None	None
	5005	56	56	315	630	5	5	None	None	None	None
Zeda	Zeda 589	64	64	400	1600	None	20	None	n/a	None	None
	Zeda 582-15	64	64	200	400	5	10	None	n/a	None	None
	Zeda 529	64	64	200	800	None	None	None	None	None	None
Zenith Data Systems	Z-89	48	64	102	2300	None	10	None	None	None	None
	Z-90	64	64	204	3500	None	10	None	None	None	None

n/a = information not available

None = not available from manufacturers; in many cases available through outside sources

Table 3. Systems Software Data

MANUFACTURER	SYSTEM	OPERATING SYSTEM		PROGRAMMING LANGUAGES					
		Single User	Multi User	Assembler	Basic	Cobol	Fortran	Pascal	Other
ADDS	Multivision 1	MUON	None	Opt	Opt	None	None	None	None
	Multivision 2	MUON	None	Opt	Opt	None	None	None	None
	Multivision 3	None	MUON	Opt	Opt	None	None	None	None
Alpha Micro	AM-1021	None	AMOS	Std	Std	None	None	Std	Lisp
	AM-1041	None	AMOS	Std	Std	None	None	Std	Lisp
Altos Computer	8000-2	CP/M	MP/M	None	Opt	Opt	Opt	Opt	PL1
	8000-15	CP/M	MP/M	None	Opt	Opt	Opt	Opt	PL1
	8000-10	CP/M	MP/M	None	Opt	Opt	Opt	Opt	PL1
AM Jacquard Systems	J100	Std	Opt	Std	Opt	None	None	None	Opt
Apple	Apple II	DOS/Pascal	None	Std	Std	None	Opt	Opt	Pilot
	Apple III	SOS	None	n/a	Opt	None	None	Opt	None
Archives Inc.	Archives-I	CP/M	None	Opt	Opt	Opt	Opt	Opt	None
	Archives-II	CP/M	None	Opt	Opt	Opt	Opt	Opt	None
	Archives-III	CP/M	None	Opt	Opt	Opt	Opt	Opt	None
Astrocom Corporation	S-760	None	Oasis	None	Std	None	None	None	None
Basic Four	S80	BOSS	BOSS	None	Std	None	None	None	None
California Computer Systems	CCS 300	CP/M	Opt	Std	Std	Opt	Opt	Opt	None
	CCS 400	CP/M	Opt	Std	Std	Opt	Opt	Opt	None
	CCS 410	CP/M	Opt	Std	Std	Opt	Opt	Opt	None
Codata Systems Corporation	CTS-100/6	CP/M	None	Std	Opt	Opt	Opt	Opt	None
	CTS-200/6	Xenix	Xenix	Std	Opt	Opt	Opt	Opt	Std
	CTS-300/6	Xenix	Xenix	Std	Opt	Opt	Opt	Opt	Std
Columbia Data Products	DC-100-8	CP/M	MP/M	Std	Opt	Opt	Opt	Opt	None
	1811-20	CP/M	MP/M	Std	Opt	Opt	Opt	Opt	None
	964-20	CP/M	MP/M	Std	Opt	Opt	Opt	Opt	None
Commodore	CBM 8032	Std	None	Opt	Std	None	None	Opt	None
	CBM 4032	Std	None	Opt	Std	None	None	Opt	None
	CBM 4016	Std	None	Opt	Std	None	None	Opt	None
Compal	Compal 8200	CP/M	None	Std	Std	Opt	Opt	Opt	Forth
	Compal EzType	CP/M	None	Std	Std	Opt	Opt	Opt	Forth
COMX World Operations Ltd.	DL-1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Cromemco	System One	Opt	Opt	Opt	Opt	Opt	Opt	None	C/Lisp
	System Three	Opt	Opt	Opt	Opt	Opt	Opt	None	C/Lisp
	Z-2H Hard Disk	Opt	Opt	Opt	Opt	Opt	Opt	None	C/Lisp
Digilog Business Systems	System 1000	CP/M	None	None	Std	Opt	None	None	None
	System 1500	CP/M	None	None	Std	Opt	None	None	None
Digital Microsystems	HiNet DSC-3/101	CP/M	Opt	Opt	Opt	Opt	Opt	Opt	Opt
	DSC-4	CP/M	Opt	Opt	Opt	Opt	Opt	Opt	Opt
Distributed Computer Systems	DCS/80	CP/M	MP/M	Opt	Opt	Opt	Opt	Opt	PL/I
	DCS/86	CPM/86	MPM/86	Opt	Opt	Opt	Opt	Opt	PL/I
Dynabyte	5505	CP/M	MPM/Oasis	Opt	Opt	Opt	Opt	Opt	PL/I
	5700	CP/M	MPM/Oasis	Opt	Opt	Opt	Opt	Opt	PL/I
Exidy Systems Inc.	Efficiency	CP/M	None	Opt	Opt	Opt	Opt	Opt	None
	System 80	CP/M	None	Opt	Opt	Opt	Opt	Opt	None
	Multi-Net 80	MP/M	MP/M	Opt	Opt	Opt	Opt	Opt	None
Findex	234	Opt	None	Opt	Std	Opt	Opt	Opt	PL1/APL
	105	Opt	None	Opt	Std	Opt	Opt	Opt	PL1/APL
Gnat Computers, Inc.	10	CP/M	None	Opt	Opt	Opt	Opt	Opt	PL/I
	10M	CP/M	None	Opt	Opt	Opt	Opt	Opt	PL/I
	10H	CP/M	None	Opt	Opt	Opt	Opt	Opt	PL/I
Hewlett-Packard	HP-85	Std	None	Opt	Std	None	None	None	None
	HP 125	CP/M	None	Opt	Opt	Opt	Opt	Opt	PL/I
IBM	Personal Computer	DOS/CP/M	None	None	Opt	None	None	Opt	None
Integrated Business Computers	Cadet	Opt	Opt	Opt	Opt	Opt	Opt	Opt	PL/I
	Ensign	Opt	Opt	Opt	Opt	Opt	Opt	Opt	PL/I
IMS International	5000 SX	CP/M	MP/M	Opt	Opt	Opt	Opt	Opt	Opt
	8000	CP/M	MP/M	Opt	Opt	Opt	Opt	Opt	Opt
Intertec Data Systems	SuperBrain	CP/M	None	Std	Opt	None	Opt	None	None
	SuperBrain QD	CP/M	None	Std	Opt	None	Opt	None	None
	Compustar Model 10	CP/M	None	Std	Opt	None	Opt	None	None

n/a = information not available

None = not available from manufacturers; in many cases available through outside sources

Table 3. Systems Software Data (continued)

MANUFACTURER	SYSTEM	OPERATING SYSTEM		PROGRAMMING LANGUAGES					
		Single User	Multi User	Assembler	Basic	Cobol	Fortran	Pascal	Other
Ithaca Intersystems, Inc.	CB-128 SFPL	Std	None	None	None	None	None	Opt	None
	PDS-80 SFPL	Std	None	None	None	None	None	Std	None
	DPS-8000	None	Std	None	None	None	None	Std	C
Lazor Systems	Lazor 5	None	MLX	Opt	Std	Opt	None	None	None
	Lazor 30	None	MLX	Opt	Std	Opt	None	None	None
	Lazor 80	None	MLX	Opt	Std	Opt	None	None	None
Logical Machine Corporation	David	Std	None	None	None	None	None	None	English
	Tina	Std	None	None	None	None	None	None	English
	Goliath	None	Std	None	None	None	None	None	English
MCM Computers	ABS 1500	CP/M	None	Opt	Opt	Opt	Opt	Opt	APL
	Micropower	AVS	None	None	None	None	None	None	APL
	Power	AVS	AVS	None	None	None	None	None	APL
Mercator	MBS3110	None	Busi/Basic	None	Std	None	None	None	None
	MBS4111	None	Busi/Basic	None	Std	None	None	None	None
Micro Five Corporation	Microstar I	Std	Std	None	Std	None	None	None	None
	Microstar II	Std	Std	None	Std	None	None	None	None
	Series 3000	Std	Std	None	Std	None	None	None	None
Micromation	Mariner	CP/M	MP/M	Opt	Opt	Opt	Opt	Opt	APL, PL/1
	M/System	CP/M	MP/M	Opt	Opt	Opt	Opt	Opt	APL, PL/1
Mohawk Data Sciences	System 21/10	Std	None	None	None	Opt	None	None	MOBOL
	MDS Series 21	None	Std	None	None	Opt	None	None	MOBOL
North Star Computer	Horizon	Opt	Opt	None	Opt	Opt	Opt	Opt	None
	Advantage	Opt	None	None	Opt	Opt	Opt	Opt	Graphics
Osborne Computer Corporation	Osborne 1	CP/M	None	None	Std	None	None	None	None
PolyMorphic Systems	System 8813	Std	Opt	Std	Std	Opt	Opt	Opt	None
	System 8810	Std	None	Std	Std	Opt	Opt	Opt	None
	System 88/HD	Std	Opt	Std	Std	Opt	Opt	Opt	None
Prodigy Systems, Inc.	Prodigy I	Protege	Opt	Std	Opt	Opt	Opt	Opt	None
Radio Shack	TRS-80 Model III	TRSDOS	None	Opt	Std	Opt	Opt	n/a	None
	TRS-80 Model II	TRSDOS	None	Opt	Std	Opt	Opt	n/a	None
Rexon	RX15	None	Recap	None	Std	None	None	None	None
	RX20-2	None	Recap	None	Std	None	None	None	None
	RX30-2	None	Recap	None	Std	None	None	None	None
Scientific Data Systems	SDS 420	Std	Opt	Std	Std	None	None	Opt	None
	SDS 423	Std	Opt	Std	Std	None	None	Opt	None
	SDS 432	Std	Opt	Std	Std	None	None	Opt	None
Smoke Signal Broadcasting	Chieftain 9822	FLEX	OS-9	Opt	Opt	Opt	Opt	Opt	Forth
	Chieftain 98W10	DOS69D	OS-9	Opt	Opt	Opt	Opt	Opt	Forth
	Chieftain 98W30	DOS69D	OS-9	Opt	Opt	Opt	Opt	Opt	Forth
Symcro Systems, Inc.	SB700	MSL	MSL	Std	Std	Opt	Opt	Opt	PL/1
Systems Group	2812	Std	Opt	Opt	Opt	Opt	Opt	Opt	None
	2829	Std	Std	Opt	Opt	Opt	Opt	Opt	None
	2842	Std	Std	Opt	Opt	Opt	Opt	Opt	None
TEI	3452	TDOS	None	Std	Std	Opt	Opt	None	None
	3482	TDOS	None	Std	Std	Opt	Opt	None	None
	Sys 48	Magic	Magic	Std	Std	Opt	Opt	None	None
Televideo	TS801	Std	None	None	None	Opt	None	None	None
	TS806	Std	Opt	None	None	Opt	None	None	None
	TS816	Std	Opt	None	None	Opt	None	None	None
TSC	BC2308	Opt	Opt	Opt	Opt	None	None	Opt	None
Vector Graphic, Inc.	2600	CP/M	None	Std	Std	Opt	Opt	Opt	APL
	3005	CP/M	None	Std	Std	Opt	Opt	Opt	APL
	5005	CP/M	Std	Std	Std	Opt	Opt	Opt	APL
Zeda	Zeda 589	None	Std	None	Opt	None	None	None	None
	Zeda 582-15	None	Std	None	Opt	None	None	None	None
	Zeda 529	Std	None	None	Opt	None	None	None	None
Zenith Data Systems	Z-89	Std	None	Opt	Opt	Opt	Opt	Opt	None
	Z-90	Std	None	Opt	Opt	Opt	Opt	Opt	None

n/a = information not available

None = not available from manufacturers; in many cases available through outside sources

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Table 4. Applications Software Data

Manufacturer	System	Word Processing	DBMS	General Ledger	Accounts Payable	Accounts Receivable	Payroll	Inventory Control	Others
ADDS	Multivision 1	Opt	Opt	Opt	Opt	Opt	None	Opt	FPL
	Multivision 2	Opt	Opt	Opt	Opt	Opt	None	Opt	FPL
	Multivision 3	Opt	Opt	Opt	Opt	Opt	None	Opt	FPL
Alpha Micro	AM-1021	Std	None	Opt	Opt	Opt	Opt	Opt	ISAM, SORT
	AM-1041	Std	None	Opt	Opt	Opt	Opt	Opt	ISAM, SORT
Altos Computer	8000-2	None	None	None	None	None	None	None	None
	8000-15	None	None	None	None	None	None	None	None
	8000-10	None	None	None	None	None	None	None	None
AM Jacquard Systems	J100	Opt	None	Opt	Opt	Opt	Opt	None	None
Apple	Apple II	Opt	None	Opt	Opt	Opt	None	None	Mail list
	Apple III	Opt	None	Opt	Opt	Opt	None	None	Mail list
Archives Inc.	Archives-I	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
	Archives-II	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
	Archives-III	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
Astrocom Corporation	S-760	Opt	Opt	Std	Std	Std	Std	Std	n/a
Basic Four	S80	Opt	None	Opt	Opt	Opt	Opt	Opt	Opt
California Computer Systems	CCS 300	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
	CCS 400	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
	CCS 410	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
Codata Systems Corporation	CTS-100/6	None	None	None	None	None	None	None	None
	CTS-200/6	None	None	None	None	None	None	None	None
	CTS-300/6	None	None	None	None	None	None	None	None
Columbia Data Products	DC-100-8	None	None	None	None	None	None	None	None
	1811-20	None	None	None	None	None	None	None	None
	964-20	None	None	None	None	None	None	None	None
Commodore	CBM 8032	Opt	Opt	None	None	None	None	None	None
	CBM 4032	Opt	Opt	None	None	None	None	None	None
	CBM 4016	Opt	Opt	None	None	None	None	None	None
Compal	Compal 8200	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
	Compal EzType	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
COMX World Operations Ltd.	DL-1	n/a	n/a	None	None	None	None	None	n/a
Cromemco	System One	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Graphics
	System Three	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Graphics
	Z-2H Hard Disk	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Graphics
Digilog Business Systems	System 1000	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
	System 1500	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
Digital Microsystems	HiNet DSC-3/101	Opt	None	None	None	None	None	None	None
	DSC-4	Opt	None	None	None	None	None	None	None
Distributed Computer Systems	DCS/80	None	None	None	None	None	None	None	None
	DCS/86	None	None	None	None	None	None	None	None
Dynabyte	5505	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
	5700	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
Exidy Systems Inc.	Efficiency	Std	Opt	Opt	Opt	Opt	Opt	Opt	Opt
	System 80	Std	Opt	Opt	Opt	Opt	Opt	Opt	Opt
	Multi-Net 80	Std	Opt	Opt	Opt	Opt	Opt	Opt	Opt
Findex	234	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
	105	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
Gnat Computers, Inc.	10	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Conte, RBTE
	10M	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Conte, RBTE
	10H	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Conte, RBTE
Hewlett-Packard	HP-85	None	None	None	None	None	None	None	VisiC, Graphics
	HP 125	Opt	Opt	Opt	Opt	Opt	Opt	Opt	VisiC, Graphics
IBM	Personal Computer	Opt	None	Opt	Opt	Opt	None	None	VisiCalc
Integrated Business Computers	Cadet	None	None	None	None	None	None	None	None
	Ensign	None	None	None	None	None	None	None	None
IMS International	5000 SX	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
	8000	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
Intertec Data Systems	SuperBrain	None	None	None	None	None	None	None	None
	SuperBrain QD	None	None	None	None	None	None	None	None
	Compustar Model 10	None	None	None	None	None	None	None	None

n/a = information not available

None = not available from manufacturers; in many cases available through outside sources

Table 4. Applications Software Data (continued)

Manufacturer	System	Word Processing	DBMS	General Ledger	Accounts Payable	Accounts Receivable	Payroll	Inventory Control	Others
Ithaca Intersystems, Inc.	CB-128 SFPL	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Mail list
	PDS-80 SFPL	Opt	Opt	Opt	Opt	Opt	Opt	Opt	None
	DPS-8000	None	None	None	None	None	None	None	None
Lazor Systems	Lazor 5	Opt	None	Opt	Opt	Opt	Opt	Opt	Opt
	Lazor 30	Opt	None	Opt	Opt	Opt	Opt	Opt	Opt
	Lazor 80	Opt	None	Opt	Opt	Opt	Opt	Opt	Opt
Logical Machine Corporation	David	None	None	None	None	None	None	None	None
	Tina	None	None	None	None	None	None	None	None
	Goliath	None	None	None	None	None	None	None	None
MCM Computers	ABS 1500	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
	Micropower	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
	Power	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
Mercator	MBS3110	None	Opt	Opt	Opt	Opt	Opt	Opt	Job cost
	MBS4111	None	Opt	Opt	Opt	Opt	Opt	Opt	Job cost
Micro Five Corporation	Microstar I	Opt	Std	Opt	Opt	Opt	Opt	Opt	Opt
	Microstar II	Opt	Std	Opt	Opt	Opt	Opt	Opt	Opt
	Series 3000	Opt	Std	Opt	Opt	Opt	Opt	Opt	Opt
Micromation	Mariner	None	None	None	None	None	None	None	None
	M/System	None	None	None	None	None	None	None	None
Mohawk Data Sciences	System 21/10	Opt	None	None	None	None	None	None	None
	MDS Series 21	Opt	None	None	None	None	None	None	Electronic mail
North Star Computer	Horizon	Opt	Opt	Opt	Opt	Opt	None	Opt	ADS
	Advantage	Opt	Opt	Opt	Opt	Opt	None	Opt	ADS
Osborne Computer Corporation	Osborne 1	Std	Opt	None	None	None	None	None	SuperCalc
PolyMorphic Systems	System 8813	Opt	Opt	Opt	Opt	Opt	Opt	Opt	MaiList
	System 8810	Opt	Opt	Opt	Opt	Opt	Opt	Opt	None
	System 88/HD	Opt	Opt	Opt	Opt	Opt	Opt	Opt	None
Prodigy Systems, Inc.	Prodigy I	Opt	Opt	Std	Std	Std	Std	Opt	Opt
Radio Shack	TRS-80 Model III	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Financial Plan
	TRS-80 Model II	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Financial Plan
Rexon	RX15	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
	RX20-2	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
	RX30-2	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
Scientific Data Systems	SDS 420	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Med/Leg Billing
	SDS 423	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Med/Leg Billing
	SDS 432	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Med/Leg Billing
Smoke Signal Broadcasting	Chieftain 9822	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Medical
	Chieftain 98W10	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Medical
	Chieftain 98W30	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Medical
Symcro Systems, Inc.	SB700	Std	Std	Opt	Opt	Opt	Opt	Opt	Medical/Legal
Systems Group	2812	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
	2829	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
	2842	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Opt
TEI	3452	Opt	Opt	None	None	None	None	None	None
	3482	Opt	Opt	None	None	None	None	None	None
	Sys 48	Opt	Std	None	None	None	None	None	None
Televideo	TS801	None	None	None	None	None	None	None	None
	TS806	None	None	None	None	None	None	None	None
	TS816	None	None	None	None	None	None	None	None
TSC	BC2308	None	None	None	None	None	None	None	None
Vector Graphic, Inc.	2600	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Financial Plan
	3005	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Financial Plan
	5005	Opt	Opt	Opt	Opt	Opt	Opt	Opt	Financial Plan
Zeda	Zeda 589	Opt	Opt	Opt	Opt	Opt	Opt	None	Med/Leg Billing
	Zeda 582-15	Opt	Opt	Opt	Opt	Opt	Opt	None	Med/Leg Billing
	Zeda 529	Opt	None	Opt	Opt	Opt	Opt	None	None
Zenith Data Systems	Z-89	Opt	Opt	Opt	Opt	Opt	Opt	Opt	SuperCalc
	Z-90	Opt	Opt	Opt	Opt	Opt	Opt	Opt	SuperCalc

n/a = information not available

None = not available from manufacturers; in many cases available through outside sources

Table 5. Corporate Data

Manufacturer's Name and Address	When Established	Dealers		Service Centers		System's 1st Delivery	Total Delivered
		U.S.	Foreign	U.S.	Foreign		
Applied Digital Data Systems Inc. 100 Marcus Blvd., Hauppage, NY 11787	1969	n/a	n/a	n/a	n/a	1980	n/a
Alpha Micro Systems 17881 Sky Park N., Irvine, CA 92713	1977	200	n/a	29	n/a	1977	n/a
Altos 2360 Bering Dr., San Jose, CA 95131	1977	200	150	50	25	1977	15,000
AM Jacquard Systems 3340 Ocean Park Blvd. Santa Monica, CA 90405	1969	40	30	50	30	1977	n/a
Apple Computer 10260 Bandley Dr. Cupertino, CA 95014	1976	1,000 +	1,000 +	1,000 +	1,000 +	1977	250,000
Archives Inc. 404 W. 35th St. Davenport, IA 52804	1978	n/a	n/a	n/a	n/a	1979	1,500
Astrocom Corporation 120 W. Plato Blvd. St. Paul, MN 55107	1968	n/a	n/a	n/a	n/a	1979	40
Basic Four Information Systems Division 14101 Myford Rd. Tustin, CA 92680	1971	83	n/a	83	n/a	1980	n/a
California Computer Systems 250 Caribbean Dr. Sunnyvale, CA 94086	1978	n/a	n/a	25	n/a	1981	500
Codata Systems Corporation 285 N. Wolfe Rd. Sunnyvale, CA 94086	1979	None	None	n/a	None	1981	n/a
Columbia Data Products Inc. 8990 Route 108 Columbia, MD 21045	1975	50	20	1	n/a	1976	500
Commodore Business Machines 681 Moore Rd., 300 Valley Forge Square King of Prussia, PA 19406	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Compal, Inc. 6300 Variel Ave. Woodland Hills, CA 91367	1976	n/a	n/a	n/a	n/a	1976	700 +
COMX World Operation Ltd. 3/F Gaylord Comm. Bldg., 114-120 Lockhart Rd. Wanchai, Hong Kong	1980	n/a	n/a	1	6	1981	n/a
Cromemco, Inc. 280 Bernardo Ave. Mountain View, CA 94043	1975	350 +	100 +	350 +	100 +	1981 1978 1980	n/a
Digilog Business Systems, Inc. P.O. Box 355 Montgomeryville, PA 18936	1969	30	5	None	None	1981	n/a
Digital Microsystems, Inc. 1840 Embarcadero Oakland, CA 94606	1968	30 +	10 +	n/a	n/a	1980 1980 1981	500 +
Distributed Computer Systems 223 Crescent St. Waltham, MA 02154	1978	n/a	n/a	n/a	n/a	1979 1981	200 + 25
Dynabyte 521 Cottonwood Dr. Milpitas, CA 95035	1977	218	38	218	38	1978	4,500 +
Exidy Systems, Inc. 631 River Oaks Pkwy. San Jose, CA 95134	1978	n/a	n/a	n/a	None	1978	15,000
Findex 20775 S. Western Torrance, CA 90501	1978	5	20	3	20	1978	900
Gnat Computers Inc. 7895 Convoy Ct., Bldg. 6 San Diego, CA 92111	1972	22	4	18	4	1979	250
Hewlett-Packard Co. 3000 Hanover Palo Alto, CA 94304	1939	100 +	100 +	100 +	100 +	1980 1981	n/a
IBM Information Systems Division P.O. Box 1328 Boca Raton, FL 33432	1924	n/a	n/a	n/a	n/a	1981	n/a
IBC/Integrated Business Computers 21592 Marilla St. Chatsworth, CA 91311	1979	40	20	1	None	1979	n/a
IMS International 2800 Lockheed Way Carson City, NV 89701	1975	60	20	1	3	1976	5,000

n/a = information not available

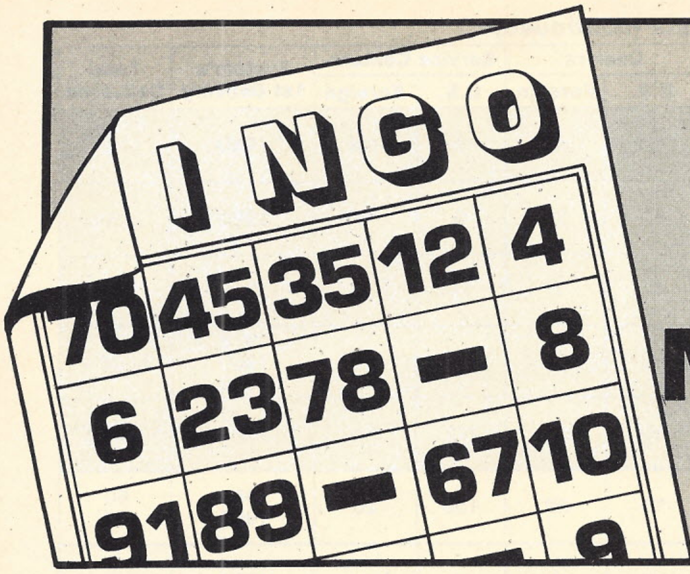
None = not available from manufacturers; in many cases available through outside sources

Table 5. Corporate Data (continued)

Manufacturer's Name and Address	When Established	Dealers		Service Centers		System's 1st Delivery	Total Delivered
		U.S.	Foreign	U.S.	Foreign		
Intertec Data Systems 2300 Broad River Rd. Columbia, SC 29210	1973	n/a	n/a	n/a	n/a	1980	n/a
Ithaca Intersystems P.O. Box 91 Ithaca, NY 14850	1977	80	10	0	0	1980	2,000
Lazor Systems Inc. 1050 E. Duane Ave. Sunnyvale, CA 94086	1978	17	2	17	2	1980	75
Logical Machine Corporation 1294 Hammerwood Ave. Sunnyvale, CA 94086	1976	30	23	5	23	1978 1980 1980	3,000 +
MCM Computers Ltd. 6815 Rexwood Rd. Mississauga, Ontario, Canada	1971	n/a	n/a	n/a	n/a	1974	1,500
Mercator Business Systems 1294 Lawrence Station Rd. Sunnyvale, CA 94086	1979	16	20	150	20	1981 1980	60 90
Micro Five Corporation 17791 Sky Park Circle Irvine, CA 92714	1977	n/a	n/a	n/a	None	1978	n/a
Micromation, Inc. 1620 Montgomery St. San Francisco, CA 94111	1977	n/a	n/a	n/a	n/a	1980	1,000
Mohawk Data Sciences 7 Century Dr. Parsippany, NJ 07054	1964	300 +	n/a	100 +	100 +	1977	n/a
North Star Computer, Inc. 14440 Catalina St. San Leandro, CA 94577	1976	400	40	50	40	1978	28,000
Osborne Computer Corporation 26500 Corporate Ave. Hayward, CA 94545	1981	96	n/a	96	n/a	1981	1,775
PolyMorphic Systems 460 Ward Dr. Santa Barbara, CA 93111	1975	n/a	n/a	n/a	n/a	1975	8,000
Prodigy Systems, Inc. 497 Lincoln Hwy. Iselin, NJ 08830	1979	18	4	18	4	1979	150
Radio Shack 1300 One Tandy Center Fort Worth, TX 76102	1927	6,146	1,928	170	n/a	1980 1979	n/a
Rexon Business Machines Corporation 5800 Uplander Way Culver City, CA 90230	1978	80	n/a	6	n/a	1979	800
Scientific Data Systems 344 Main St. Venice, CA 90291	1977	30	2	27	2	1979	400
Smoke Signal Broadcasting 31336 Via Colinas Westlake Village, CA 91362	1976	120	55	120	55	1980 1981 1981	350 50 25
Symcro Systems, Inc. 7300 Crescent Blvd. Pennsauken, NJ 08110	1977	7	2	7	2	1981	5
Systems Group 1601 Orangewood Ave. Orange, CA 92668	1978	175	50	n/a	n/a	1981	n/a
TEI Inc. 5075 S. Loop E. Houston, TX 77033	1968	20	12	3	12	1977	2,500 +
Televideo Systems, Inc. 1170 Morse Ave. Sunnyvale, CA 94086	n/a	n/a	n/a	n/a	n/a	1981	n/a
TSC Box 683 Hanover, NH 03755	n/a	n/a	n/a	30	n/a	1981	15 +
Vector Graphic, Inc. 500 N. Ventu Park Rd. Thousand Oaks, CA 91320	1976	380	40	30	n/a	1981	n/a
Zeda Computer International 1662 W. 820 North Provo, UT 84601	n/a	35	None	1	None	1979	n/a
Zenith Data Systems 1000 Milwaukee Ave. Glenview, IL 60025	1979	278	53	254	52	1979	n/a

n/a = information not available

None = not available from manufacturers; in many cases available through outside sources



Inquiry Handling with a Microcomputer

by Rocky Smolin

If the old "What's My Line" quiz show would still be on television, Marsha Sutton of Sutton Communications in San Diego, CA, would have a real stumper. She operates Bingo, a service that processes the inquiries generated by a company's advertising and public relations efforts.

Bingo cards are familiar to readers of trade publications. They're the postcards in the back of the magazine covered with numbers. When one sees an interesting product, one circles the reader service number on the card that corresponds to the one printed with the ad or product announcement and mails the card back to the magazine. The magazine keys the readers' names and addresses and all the circled numbers into its computers, which eventually sort out each advertiser's responses and print them on mailing labels. The magazines send these labels to the advertisers who, hopefully, will ship literature off to the reader.

"The idea came to me when I was working for a computer company in the Los Angeles area," says Sutton. "It was perhaps eight months after the National Computer Conference. In the process of moving the offices around, we opened up one room that was piled, literally thigh deep, with requests for information on the company's products. And not all the inquiries were from NCC either. This was apparently the dumping ground for all sorts of inquiries generated from the firm's advertising and public relations exposure. Since I had seen similar situations in other companies, I knew the reasons why they found it so difficult and expensive to process these inquiries. I

Figure 1. Four information categories

```
Bingo - Sales Inquiry Handling Service
CODED FILES LISTING
FOR : WESTERN WIDGET WORLD, INC.


PUBLICATIONS/SOURCES
--------------------
 1 ) WIDGET WORLD
 2 ) MODERN WIDGETS
 3 ) WIDGET WEEKLY
========================================

AREAS
--------------------
 1 ) CANADA
 2 ) EAST
 3 ) CENTRAL
 4 ) SOUTH
 5 ) SOUTHWEST
 6 ) NORTHWEST
========================================

ITEMS
--------------------
 1 ) AD - S-100 WIDGET
 2 ) AD - NEW TURBO-WIDGET
 3 ) PR - NEW MFG. FACILITY
 4 ) PR - GASAHOL FROM WIDGETS
 5 ) AD - 1-CENT SALE
========================================

LITERATURE
--------------------
 1 ) BROCHURE
 2 ) DATA SHEET
 3 ) PRODUCT DESCRIPTION
========================================
```

INTRODUCING CALCSTAR.™ ANOTHER INDISPENSABLE BUSINESS PROGRAM FROM MICROPRO,™ THE WORDSTAR™ PEOPLE.

Presenting CalcStar—another standard-setting software product in the WordStar tradition.

CalcStar is MicroPro's new electronic spread sheet and financial modeling program—a sophisticated, yet easy to use, calculating and planning tool for CP/M®-based computers.

The ultimate electronic spread sheet. CalcStar calculates solutions to complex numerical problems in business and finance. Helps you make budget plans and sales forecasts with greater speed and accuracy. And projects figures into the future to answer the "what if" questions you face in business.

And CalcStar also has a unique MicroPro advantage: It joins with WordStar to combine spread-sheet and word-processing capabilities in several powerful ways.

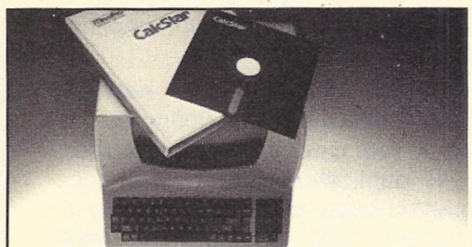
CalcStar software eliminates the need to use ledger paper ever again. It turns your video screen into a "window" on a giant electronic ledger sheet, with up to 600 entries arranged the way you want. Then, by inserting formulas into CalcStar, you create financial models that simulate the future numerically. And predict the outcomes of your business decisions.

When you notice what CalcStar can do for your business, you'll wonder how you ever got along without it. (If you're now a WordStar user, you probably already know the feeling.)

The MicroPro bonus. Like WordStar, CalcStar is packed with innovative features that make it versatile and easy to use. Features like Automatic Forms Mode, which lets an inexperienced user enter data into a spread sheet quickly and with less chance of error.

CalcStar's greatest innovation is its ability to join with WordStar. Which means, for example, you can use WordStar's printing options, like boldface and underlining, to dress up financial documents. And you can insert sections of CalcStar's spread sheets into your WordStar documents.

This kind of flexibility should come as no surprise if you're already familiar with the MicroPro software family—a line of programs designed to work together to multiply your problem-solving power. Visit your MicroPro dealer to find out just how big a difference *all* our products can make in your business. We predict you'll discover it's not just CalcStar or WordStar that's indispensable. It's MicroPro.



A glance at CalcStar features

Runs on CP/M version 2.0 or above, with 80-column screen, addressable cursor, and at least 48K memory. 56K or more is recommended for fullest utilization.

Highly user friendly: Call up full screen of help or use help menu. WordStar-like cursor commands. User's guide shows you the basics. Install from menu OR a WordStar file.

Stores formulas and formats along with data, for convenience and less chance of error.

Math functions include average, minimum, maximum, logarithms, exponents, and regression analysis.

SOFTWARE THAT MEANS BUSINESS

MicroPro™

INTERNATIONAL CORPORATION

1299 Fourth Street, San Rafael, California 94901
(415) 457-8990; Telex: 340-388

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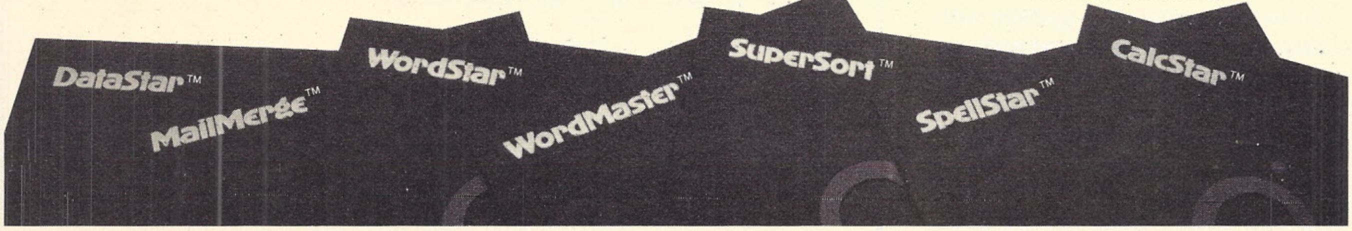


thought that a service to perform this task would be very attractive."

And this, indeed, was the case. Bingo actually solves two problems. The first, of course, is to send the information out to the reader in a timely way. The second is filing management reports on which publications and ads are drawing the most inquiries, how much interest is being generated by each item, and where the inquiries are coming from.

"I use a Radio Shack model II," says Sutton, "to enter the responses, print out mailing labels and generate the management reports and lead lists. Although many people look down their noses at the model II, I've never been able to understand it. For price, reliability and performance, I find the machine to be hard to beat.

"The system is my own design—the report layouts, screens, files, etc.—but I had the software written by an independent consultant. Each diskette holds about 1,000 inquiries, more than enough for one month's responses for the size of company I contract with."

Before initiating the service, Sutton has the client define a sign off on four categories of information —1) publications/sources; 2) geographic sales areas; 3) products of interest; and 4) literature (see figure 1).

These descriptions are stored in a separate file. During data entry, only the codes are entered for these items. The descriptions are displayed on the screen to confirm that the right item has been selected. In the response files, only the codes for the items are stored. This approach saves both disk space and keystrokes.

"The client provides me with the literature and envelopes, and a deposit for postage." Sutton added. "When leads come into the client's office, they forward them to me and I do the rest." The 'rest' consists of keying in the lead information, and producing the management reports on a weekly and monthly basis.

Sutton designed the system with plenty of company name and address space. Experience in overseas public relations taught her how long some names and addresses can get. There are fields as well for title and phone number. The 'status' and 'miscellaneous' fields can be used for anything, but they generally contain information about the in-

```
                                                                SEP. 23, 1981
BINGO - SALES INQUIRY HANDLING SERVICE                 FROM: 05/17/81 - 05/23/81
WEEKLY SALES REPORT - LEAD LIST                                      PAGE :  2
FOR : WESTERN WIDGET WORLD, INC.
AREA: CENTRAL

---------------------------------------------------------------------------
  NAME  : LYNCH, MERRILL                           RECORD #    :   45
  TITLE : MARKETING SALES MGR.                     ISSUE/SHOW  : 05/01/81
  FIRM  : OCTOPUS, INC.                            LEAD REC'D. : 05/19/81
        :                                          LIT. OUT    : 05/20/81
  ADDR  : 2525 EFFLUENT AVE.                       RESPONSE    : 1
        : CLEVELAND, OH  44143                     LIT. SENT   : 1
        :                                          PHONE       : (216) 567-7890
  INQUIRING ABOUT: AD - NEW TURBO-WIDGET
  AREA           : CENTRAL
  AS SEEN IN     : MODERN WIDGETS

  STATUS : PR: 50-99 EMP.
  MISC.  :

  CONTACT BY PHONE:               EVALUATION:
  CONTACT BY VISIT:
---------------------------------------------------------------------------
  NAME  : RUGGIN, RONALD                           RECORD #    :   44
  TITLE : ENGINEER                                 ISSUE/SHOW  : 05/01/81
  FIRM  : WIDGEWAY, INC.                           LEAD REC'D. : 05/19/81
        :                                          LIT. OUT    : 05/20/81
  ADDR  : P. O. BOX 4077, DEPT. 23                 RESPONSE    : 1
        : WICHITA, KS  67277                       LIT. SENT   : 1
        :                                          PHONE       : (   )    -
  INQUIRING ABOUT: AD - NEW TURBO-WIDGET
  AREA           : CENTRAL
  AS SEEN IN     : MODERN WIDGETS

  STATUS : PR: 1000-2499 EMP.
  MISC.  :

  CONTACT BY PHONE:               EVALUATION:
  CONTACT BY VISIT:
---------------------------------------------------------------------------
  NAME  : TRIBBLE, ELROY                           RECORD #    :   43
  TITLE : MANAGER                                  ISSUE/SHOW  : 05/01/81
  FIRM  : CORNDOG SUPPLY CO.                       LEAD REC'D. : 05/19/81
        :                                          LIT. OUT    : 05/20/81
  ADDR  :                                          RESPONSE    : 1
        : ST. PAUL, MN  55144                      LIT. SENT   : 1
        :                                          PHONE       : (   )    -
  INQUIRING ABOUT: AD - NEW TURBO-WIDGET
  AREA           : CENTRAL
  AS SEEN IN     : MODERN WIDGETS

  STATUS : PR
  MISC.  :

  CONTACT BY PHONE:               EVALUATION:
  CONTACT BY VISIT:
---------------------------------------------------------------------------

                                                                SEP. 23, 1981
                                                       FROM: 05/17/81 - 05/23/81
BINGO - SALES INQUIRY HANDLING SERVICE                               PAGE :  3
WEEKLY SALES REPORT - LEAD LIST
FOR : WESTERN WIDGET WORLD, INC.
AREA: SOUTH

---------------------------------------------------------------------------
  NAME  : SHOE, JIM                                RECORD #    :   46
  TITLE : PRESIDENT                                ISSUE/SHOW  : 05/01/81
  FIRM  : CRAPSHOOT MARKETERS & ASSOC.             LEAD REC'D. : 05/19/81
        :                                          LIT. OUT    : 05/20/81
  ADDR  : 1600 PENCILVANIA AVE.                    RESPONSE    : 1
        : DELRAY BEACH, FL  33444                  LIT. SENT   : 1
        :                                          PHONE       : (305) 664-7724
  INQUIRING ABOUT: AD - NEW TURBO-WIDGET
  AREA           : SOUTH
  AS SEEN IN     : MODERN WIDGETS

  STATUS : PR: 50-99 EMP.
  MISC.  :

  CONTACT BY PHONE:               EVALUATION:
  CONTACT BY VISIT:
---------------------------------------------------------------------------
```

Figure 2. Lead information

```
BINGO - SALES INQUIRY HANDLING SERVICE                        SEP. 23, 1981
WEEKLY STATUS - TOTAL LEADS PER AREA              FROM: 05/17/81 - 05/23/81
FOR : WESTERN WIDGET WORLD, INC.                                 PAGE :  1

AREA                  ITEM OF INTEREST                      LEADS    # LEADS
                                                            1 WEEK    TOTAL
============================================================================
CENTRAL                  AD - 1-CENT SALE                     0         8
                         PR - NEW MFG. FACILITY               0         2
                         PR - GASAHOL FROM WIDGETS            0         2
                         AD - NEW TURBO-WIDGET                3         3
                                                          -------- --------
       *** TOTAL                                              3        15

EAST                     AD - 1-CENT SALE                     0        11
                         PR - NEW MFG. FACILITY               0         4
                         AD - NEW TURBO-WIDGET                2         7
                         PR - GASAHOL FROM WIDGETS            0         3
                                                          -------- --------
       *** TOTAL                                              2        25

SOUTH                    AD - NEW TURBO-WIDGET                1         1
                                                          -------- --------
       *** TOTAL                                              1         1

CANADA                   AD - S-100 WIDGET                    0         2
                                                          -------- --------
       *** TOTAL                                              0         2

SOUTHWEST                AD - 1-CENT SALE                     0         3
                                                          -------- --------
       *** TOTAL                                              0         3

NORTHWEST                AD - NEW TURBO-WIDGET                0         1
                                                          -------- --------
       *** TOTAL                                              0         1
============================================================================
       *** TOTALS                                             6        47
```

Figure 3. Leads-per-area report

quirer's business—what field they're in, the size of the company, reason for requesting the literature, etc.

Three date fields record the date of the publication or show which generated the inquiry, when it was received into the Sutton Communications offices, and when the literature was sent out (usually within 24 hours). Other fields record which response this is (first, second, third, etc.), and what literature was sent out (by code).

On a weekly basis, Sutton provides complete lead information (figure 2). At the client's option, these can be sorted by area. They can then be separated and sent to the sales agents in each area for follow-up. Clients find this to be one of the most useful features of Bingo.

It also gives the home office documentation on which to gauge the performance of the sales people in the field. (They may have them return the lead forms showing the results of their follow-up efforts.)

Also on a weekly basis, the client gets a total leads-per-area report (subtotaled by items) as shown in figure 3. In addition to telling the client where the responses are coming from, it gives them a way to audit Sutton's billing. (The service is billed on a per inquiry basis.)

This area/item report is also part of the monthly package. Other reports shown give information on responses by publication (sub-sort by item—figure 4), responses by item (sub-sort by publication—figure 5), and a total report that provides data on publications, items, and areas for the last three months, the three month totals, and the 'to date' totals—figure 6.

"This is the type of management information that allows companies to tailor advertising and promotional efforts to get the most for their investment," explains Sutton. "Although it is obvious that the whole thing could be done manually, it's impractical for more than a few leads per month. It's the computer that makes it all possible, and particularly microcomputer technology, which brings this type of equipment into a price range that small companies like mine can afford."

This company's inquiry service is just another example of the remote and unlikely corners of business and industry that are beginning to regard computers not as mysterious, sophisticated and expensive investments. They are now recognized as utility machines like the copier and typewriter—a standard part of the office equipment inventory.☐

Figures continue on page 144

The Agony and the Ecstasy of a New Computer Owner

by Dona Z. Meilach

Michelangelo would be a perfect new computer owner if he were living today. The first week or two of learning what and how to work the computer, the software, the printer, the terminal read like volume 2 of *The Agony and the Ecstasy*. One day everything works beautifully; the next day you forget a command, or you hit the wrong button and you can't understand why things work differently one time than another.

Three weeks ago, I had all the components delivered that would make me a computerized author. I thought I had researched the field thoroughly. I read several books. I sought advice from people in the know. I shopped several computer stores. I subscribed to the computer magazines and read those I hadn't subscribed to in the library. I made comparative lists for the computers; amount of memory, number of horsepower. I knew the definitions of RAM, ROM, bytes. I was talking numerals instead of words, and people were talking back to me in the same language. I wrote to several computer companies, and alphabetized all the brochures in one vast file. I joined a computer society so I would have ample brains to pick before I made my final selection.

I had so many demonstrations of word processing software, I was tired of deleting characters, moving paragraphs, and doing what I felt was rapidly becoming second nature. I was so anxious to be off and running, I held back on correspondence. Manuscripts were piling up waiting to be typed. I was like a kid waiting for Christmas. I anticipated stories and articles beautifully typed in matters of minutes. I envisioned fan-folded sheets rolling through and piling up behind the printer at such a prodiguous rate, my editors would not know what hit them. So, after much deliberation, price comparing, negotiating, studying ads and brochures until I knew each unit by heart, I emptied my bank account and purchased all the equipment. Not a turnkey system, either, but different components from different places. That way I could save quite a bit of money.

On delivery day, everything was hooked up, plugged in, fans were humming.

"O.K. You're ready to go," said the man who had installed it all. "Here's what you do. Power up the system, then hit 'B' and return."

"B? Why B?" I asked.

"For boot," he answered. "You have to boot in the system whenever you turn it on."

Everything after that was downhill. I knew nothing about testing, formatting or copying a disk, or how to use the system programs for any procedure. Every demonstration I had included all systems set up and ready to go. I didn't know what I had to know.

Total panic. I had never felt so inadequate since the days I had to take college entrance exams in chemistry. Here was this huge investment staring at me and all I could do was look at it and say "UGH." I tried to will it to "compose." I talked to it. I pleaded with it. I pushed buttons, returns, escapes, controls, but nothing that I expected happened.

There was only one thing to do. When all else fails, read the directions. The manuals, all together, weigh nearly nine pounds. I hardly knew where to start.

Manuals is almost a dirty word now. Never have I encountered such an array of hard-to-read, impossible-to-follow, over-wordy and poorly-written manuals. It's not so surprising, though. Manuals are written by people who know computers and how to speak computerese. They assume you know more than you know. They don't begin with square one. You are plunged in! To make matters almost intolerable, there are four sets of manuals tossed at you simultaneously. Consider the software, the terminal, the computer and the printer. In addition to the user's manuals, there are component manuals and scores of sheets showing diagrams. Some of the user's manuals assume you have read the component manuals first, so they skip over what you should have noted before you became a user. And who has the patience?

Inadequate? Stupid? Those words don't begin to describe the hollow-in-the-stomach feeling that grips you. That feeling clawed and clenched at me possibly more than it might others, for I am allegedly a how-to expert. I have written definitive books on how-to-do a variety of art and craft techniques including blacksmithing, woodwork, sculpture casting, furniture making, weaving and so forth. How could I let a thing like a computer throw me? What was the problem?

Support. Ah, yes. That's it. I needed *support*. When you buy equipment, software and so forth, the salesmen tell you you are buying support: "Anything you don't understand, anything that goes wrong...we'll support you." That's fine, except that support in some salesrooms includes only two hours of support time. After that, it's $25 an hour. I got all the support I needed from the people who installed the computer, but they did not know how to use the particular word processing software I had bought.

Back to the manual. Back to the menus. Back to the frustrations. Back to phoning people in the computer society and getting the help I needed. After the first week, a few rays of daylight shone through. Luckily, I attended a computer faire. The company that made the software I was struggling with was exhibiting there.

"I'm having problems." I said.

"Didn't you get any support from the people you bought it from?"

"No. I bought it mail order from a discount supplier."

"What do you expect when you buy discount? You should never buy someting like that discounted."

"Then why would you allow a discount house to represent your product?" I questioned. "What if I lived

out in East Podunk? If your manual isn't good enough to help without support available, then your product doesn't belong on the market!"

After a few rounds of that, I was informed that the company is establishing a series of seminars on how to use the program and a new manual was in the works "for people like you." The salesman smiled finally, and said, "Would you do me a favor and write your story to the president of the company?" I received a copy of the new manual during the faire...it had just been printed.

I am now at the end of week number three with my computer and I am feeling almost human again. I feel like I am beginning a recuperative period after a long illness—the sleepless nights; the wondering what I did wrong and how to right it. I am happy to report that some of it has become part of the past. The ability to find directives in the manuals and to know what they mean are all hacking away at my brain like a chisel into a hardwood log.

I am also beginning to understand "reality." For example, I realize now that during the research period, many salesmen who demonstrated the word processing package knew only the basic routines—none of the more sophisticated operations. Each knew only enough to do the razzle-dazzle.

Reality is also knowing that *everyone* goes through the same frustrations in the honeymoon days of living with a computer. The most oft repeated statement I heard was "I know what you're going through because I've been there."

Once, and only once, I flagellated myself for not having bought a turnkey system, so one company would be responsible for everything...including me. But, that old reality again flashed through my brain. No one can help you muddle through the mistakes you are bound to make and to learn how to correct them. The only thing you can do is note the mistakes you make repeatedly and then ask someone. I soon discovered that once I knew the mistakes I was making and that I could repeat them, I was able to analyze what I was doing and to correct them.

Considering the possibilities

During the moaning days, I was told that I would soon be using the computer so deftly, I'd forget all the early pangs that I had dubbed as "typewriter separation." "You will also think your typewriter is an archaic instrument." was another warning. They were right. All of them. Three weeks later, here I am writing and editing on the computer. I still have much to learn. I can't wait to go on to some of the more esoteric areas of the computer. I'm looking at modems and at the possibility of a second terminal. I'm intrigued by the software program with a dictionary that will correct my typing when I don't want to go back and do it. I'm thinking of writing a program...

I discovered something no one told me. The computer is a marvelous diet tool. I've become so intrigued, so enamored of working with it, I can sit for hours and hours without ever getting up and rummaging through the refrigerator. But after sitting so long, I'm afraid of a "computer spread." Relief consists of taking a two mile jog. What do I think about while I'm jogging? You guessed it: How can I do such and such with the computer?

Michelangelo, move over. Agony and ecstasy take many forms. □

AN INTRODUCTION TO MRP
(Materials Requirements Planning)

by Rocky Smolin

As the complexity of the manufacturing environment increases, so do the challenges of meeting production schedules—while minimizing the use of working capital. The mix of manufactured products is shifting towards items that require more labor hours, use more kinds of different skills on the manufacturing floor, have more manufacturing steps, and contain more parts. Nowhere is this more evident than in high technology environments, such as electronic equipment manufacturing.

But the problems remain: how many of each item should be built; when the production of each required item should begin; how much of each component should be ordered; when these orders should be placed; how much labor of each type will be required; and how much of each machine's time will be needed.

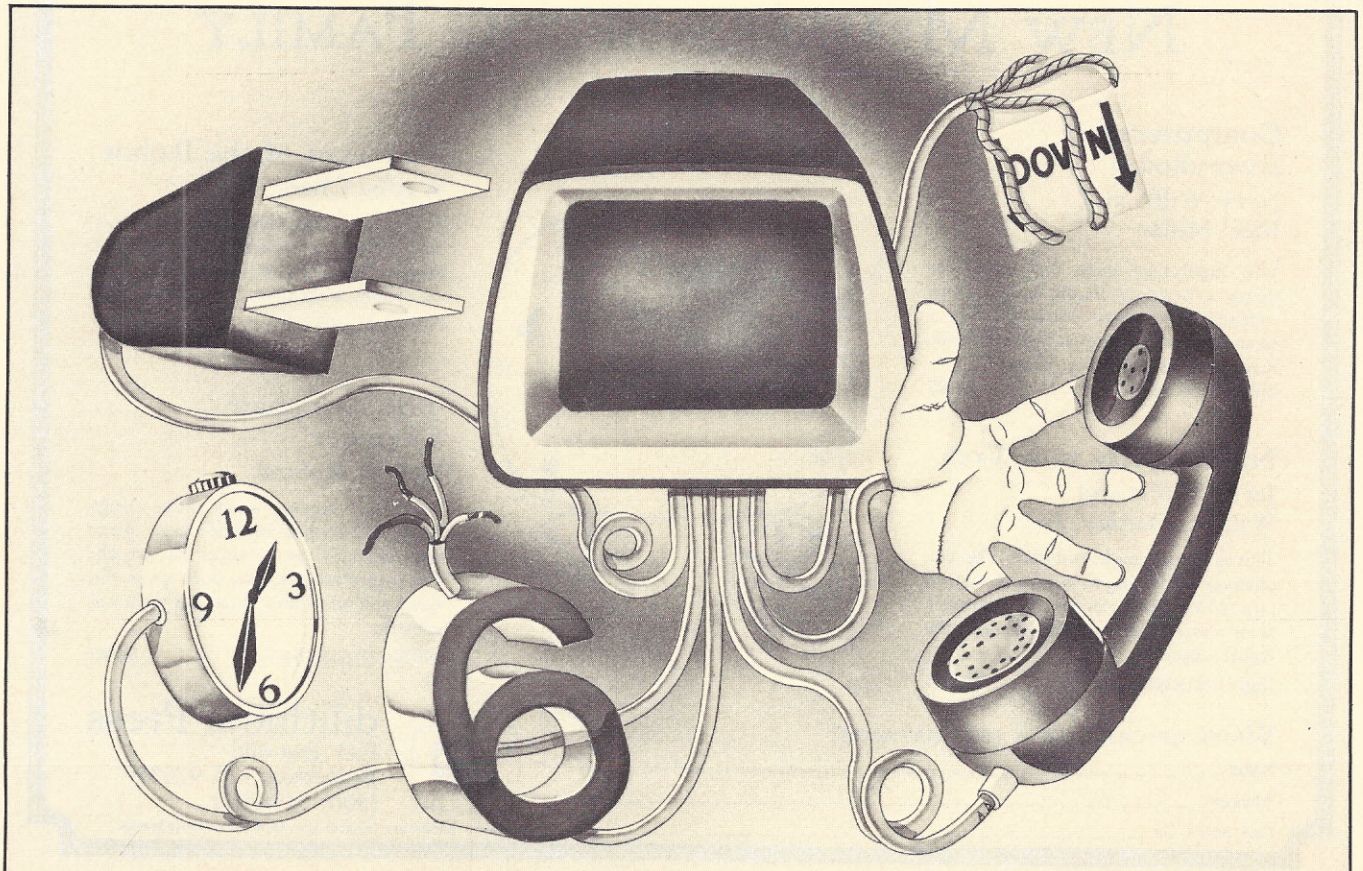
For many years, a computerized solution to these problems has been employed by large corporations—those able to justify the investment and expense of large computer systems. This process is called MRP (Materials Requirements Planning). This method gives management solutions based on: the structure and components of the items to be built; how long it takes to build them; what is in work-in-process; what is in inventory and on order; what firm orders exist; and the sales forecast for each product.

Performing this complex task obviously implies the presence of several other systems. The power of minicomputers has increased and the prices have decreased to the point where many smaller manufacturing companies now have these systems on-line. Consequently, there are many vendors who now offer MRP packages—mostly bundled together with these other subsystems—since the MRP programs require complete integration with the other applications. The advent of powerful micro-based local networks, coupled with shared disk resources of 150-200M bytes, will place MRP capability in the hands of an even greater number of manufacturing companies—current and new software houses will be offering MRP packages for these machines.

Nevertheless, the problems associated with moving from a manual system to an automated system are immense. Several systems must be on-line and the data must have very high integrity. Almost every department is affected and all must be aware of the implementation process. Departmental cooperation and support are prerequisites to success. The investment of a company's time and money is significant—it can take anywhere from 18 months to three years to implement the system.

This two-part article will provide an introduction to each subsystem required and a general description of how the MRP process works.

Of primary importance in the system is a bill of materials processor. A bill of materials is simply a list of all components that go into an assembly along with the



number of each component required and usually some cost information. Figure 1 is a bill of materials for a doo-dad.

To build a doo-dad requires four components: A, B, C, and D, and that the quantities to build a doo-dad are 1, 10, 2, and 9, repectively. Since this is a costed bill of materials, we know how much each item costs and what the extensions and total material cost (excluding labor and burden or overhead) will be.

Figure 2 is a bill of materials for a widget. The component D appears in this product as well as in the doo-dad and the doo-dad appears here as a subassembly of the widget.

Figure 3 shows the product structure for the doo-dad and figure 4 shows the product structure for the widget. The widget structure is known as a single level bill of materials. It shows the structure of the widget only down to the first level of the structure tree. The complete structure is depicted in figure 5.

These pictorial representations of a complex product help one to visualize how the product is put together.

	Item	Quan.	$/ea.	Total
Doo-dad				
	A	1	1.50	1.50
	B	10	.33	3.30
	C	2	6.50	13.00
	D	9	.05	.45
				=====
Total Cost				18.25

Figure 1. Bill of materials for a doo-dad

	Item	Quan.	$/ea.	Total
Widget				
	H	1	4.50	4.50
	I	2	6.00	12.00
	D	3	.05	.15
	Doo-dad	2	18.25	36.50
				=====
			$	53.15

Figure 2. Bill of materials for a widget

The complete bill of materials for the widget, known as indented (or indentured) bill of materials is illustrated in figure 6.

This is an uncosted indented bill of materials for the widget. Any bill of materials processor will allow for the definition of components (the lowest level item in the tree—a purchased item with no labor added to it in-house), single level bills (those containing only components), and product structures (the relationship between the components, subassemblies, and assemblies to go into the top level product).

It will produce printed bills of materials (single level, indented, costed and uncosted), and "where used" listings—that is, given a component or subassembly, it will indicate every subassembly or assembly in which that item appears. It is the cornerstone of all manufacturing systems including MRP.

The bill of materials processor will also do cost roll-ups. It will add the cost of all the components on the bottom level of the product structure and assign that total as the material cost of assemblies into which those components are assembled. Then it will roll the cost of all the assemblies in that level into their associated assemblies on the next higher level of the product structure, up the tree to the top level. The bill of

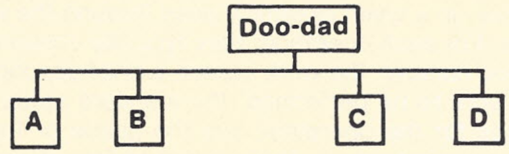


Figure 3. Doo-dad product structure

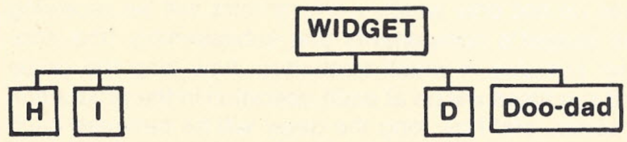


Figure 4. Widget product structure

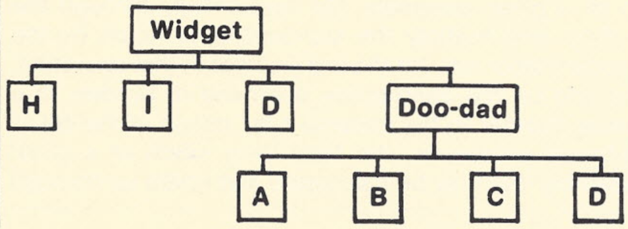


Figure 5. Complete bill of materials structure

	Item		Quantity	
Widget				
	Doo-dad		2	
		A		1
		B		10
		C		2
		D		9
	H		1	
	I		2	
	D		3	

Figure 6. Uncosted indented bill of materials

material processor tells us *what* and *how many* of each item it takes to build a certain product.

As a product moves through its production process, it passes through certain areas on the production floor in which, no matter what the product, the same type of activity takes place. Examples of this might be a machine tool; a flow solder machine; the board stuffing area; packaging; inspection; staging (where components required for a given assembly are gathered into a kit prior to releasing them to the production floor). Any

manufacturing system that supports MRP must allow the definition of work centers, including the standard hourly cost of the people who work there, the burden or overhead rate associated with it and capacity in hours per day.

Routing for product

Routings define the order in which the components that make up a given assembly pass through the work centers. For each operation, they typically contain the operation number, the work center, a brief description of the work to be performed, the standard setup and run times for the operation, and the queue or transit times required to move the product to this operation from the last one.

Figure 7 shows a hypothetical routing for the widget. Here we see the production routing for the widget. It tells us not only which work centers will be receiving the widget's components and subassembly (the doo-dad) but also in which sequence, how long the setup and run times will be at each operation in the production process, and how long the delay will be between each step in the process.

Since the standard hourly rate for each setup and run time was defined in the work center, it is now possible, using the routing to perform a labor cost roll-up on a given assembly. Go sequentially through the routing, and multiply the standard labor hours by the standard labor rate for the work center in that operation, and add on the appropriate overhead or burden. In a similar manner to the material cost roll-up of the bill of materials processor, the total labor costs of a given assembly can now be calculated and rolled up through the whole structure of a given manufactured product. The routings tell us *how long* it takes to build a given assembly or subassembly.

Next, MRP looks at inventory to determine quantity on hand. It must be able to check both finished (or manufactured) goods and raw materials. From the quantities of finished product that must be built to meet the demands of the firm's sales orders and forecast, it subtracts that which is already present in finished goods inventory that has not already been reserved against a sales order or some other demand. From the quantities of raw materials that are required to meet the demands of the manufacturing schedule, it must subtract those component quantities already present.

Like the raw materials inventory, the contents of the purchasing files tell MRP how much of the raw materials needs are already on order and when they will be delivered. To be useful to the MRP program, the purchasing files must have not only the item being purchased and the quantity, but also the due date, the quantity received, the quantity scrapped or returned to the vendor, and the quantity still due.

Oper.# Center	Work Hours	Set-up Hours	Run Time	Queue	Description
10	Stage	0.0	0.25	1.0	Verify kit
20	Solder	0.1	0.25	1.0	Solder D & I to H per blueprint
30	Inspect	0.0	0.1	1.0	Inspect solder
40	Lathe	0.5	0.75	1.0	Special machining of doo-dad per blue print
50	Inspect	0.0	0.5	1.0	Inspect tolerances
60	Assembly	0.0	1.5	1.0	Fit doo-dad & H to-gether
70	Test	0.0	10.0	1.0	Burn-in of widget
80	Packing	0.0	0.2	1.0	Pack widgets
====	====	====			
Totals		0.6	13.55	8.0	

Figure 7. Hypothetical widget routing

	Time Period 1	2	3	4	5	6
1) Forecast (widgets)	10	10	10	20	15	30
2) Unplanned orders	10	2	6	1		
3) Total Widget Demand	20	12	16	21	15	30
4) Spare Doo-dads	5	5	5	5	5	5

Figure 8. Demand factors

The work-in-process is yet another factor that reduces the quantities that MRP will tell you to build and/or buy. From the gross build requirements, it will subtract those assemblies already on the manufacturing floor. To do this, the integrated manufacturing software must have a shop floor control module that allows the recording of work orders as they are released to the floor. The system accepts transactions from the floor (on-line, hopefully) that record in the work order file what operation (from the routing) this work order is currently in, and how much time (actual cost) was spent in the last operation. The work order record also contains the item being built as well as the quantity being built in that work order, the start date and the due date.

Materials requirements planning is a demand/supply problem. To determine what to make and buy, the program first calculates aggregate or gross demands from sales forecasts, spare parts requirements, unforecasted orders, and any other source of demand

 CIRCLE INQUIRY NO. 23

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SuperCalc, Rev 1.0

	Poor	Fair	Good	Excellent
Usefulness	☐	☐	☐	☑
Documentation	☐	☐	☑	☐
Ease of Use	☐	☐	☐	☑
Error Handling	☐	☐	☐	☑

"SuperCalc has now brought the full utility of a spreadsheet simulator to the CP/M world. . .The program worked flawlessly.

"Most of the other CP/M spreadsheet simulators sidestep the terminal problem by not doing an actual real-time spread sheet...

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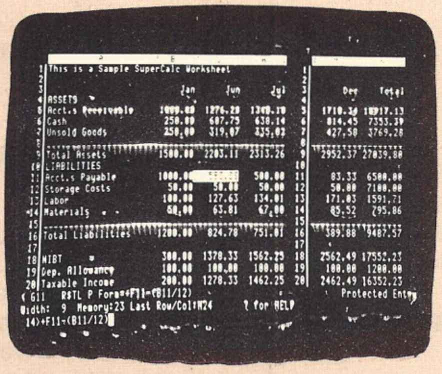

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on inventory. Figure 8 shows a hypothetical demand for the doo-dads and widgets over six time periods. An MRP time period is typically either a week or a month.

If an item in demand is an assembly—an item consisting of several components and perhaps several subassemblies with labor added—the MRP program explodes this assembly by going from the top level of this item's product structure down to the component level, creating additional demands to make you buy parts. This results in the total gross requirements, as shown in figure 9.

Now that the gross requirements for build items have been determined, the MRP program looks at the supply factors for these items that are finished goods or work in process.

Figure 10 shows that there are 20 widgets in finished goods and 50 doo-dads. Further, there are 40 of each item in work-in-process, 20 of each due to be completed in the first time period, 20 of each in the second. Now MRP can calculate the net build requirements to meet the forecast by reducing the gross build requirements by those amounts already present in finished goods and in work-in-process.

Figure 11 shows the net requirements by time period for widgets. Where net requirements are negative, it indicates that excess inventory exists. For example, in period 1, we start out with 20 widgets in finished goods. To this we add another 20 from WIP (work-in-process). From the total of 40 we will sell (forecasted and unforecasted) 20 units, leaving 20 in stock for the next period. In period 2, another 20 come out of WIP into finished goods raising the on-hand quantity to 40, but 12 are sold, leaving 28 in the stores. By the time we reach period 4, we have exhausted the on-hand supply of widgets and must complete nine widgets to meet the demand.

Gross Requirements

Time period

1	2	3	4	5	6
20	12	16	21	15	30

Widgets

Figure 9. Gross requirements

Supply Factors – Widgets & Doo-dads

Finished goods –	widgets	20
	doo-dads	50
Work-in process –	widgets	20 in period 1
(completions)		20 in period 2
	doo-dads	20 in period 1
		20 in period 2

Figure 10. Supply factors—widgets and doo-dads

Net Requirements for Widgets

Time Period

1	2	3	4	5	6
-20	-28	-12	9	15	30

Widgets

Figure 11. Net requirements for widgets

Item	Lead Time (periods)	EOQ
Widgets	2	20
Doo-dads	2	20
A	3	100
B	1	50
C	1	100
D	1	50
H	2	100
I	2	50

Figure 12. Lead times

Time period

1	2	3	4	5	6
0	9	15	30		

Widgets

Figure 13. Build schedule

Time Period

1	2	3	4	5	6
0	20	20	20		

Widgets

Figure 14. Refinement on build schedule

However, if we are to meet the demand for an additional nine widgets in period 4, we must start them earlier. How much earlier depends on how long it takes to manufacture widgets (lead time). Figure 12 shows lead times for the manufactured and purchased items as well as the economic order quantity (EOQ) (the optimum number to make or buy at one time).

To meet the requirements for on-hand widgets, the net requirements schedule must be set back by the lead time, giving us a build schedule that looks like figure 13. In order to have the nine widgets in excess of on-hand inventory in period 4, they must be started in period 2. The 15 needed for period 5 must be started in period 3, etc. However, the EOQ for widgets is 20. When they are built, the minimum quantity in one work order should be 20. So MRP must perform a last refinement on the build schedule shown in figure 14.

In period 2, we must open up a work order for 20 instead of nine, giving an excess of 11 units. This is still short of the 15 needed to start in period 3, so we open up a work order for another 20 in period 3. Now we will have an excess of 16, which is still 14 short of the 30

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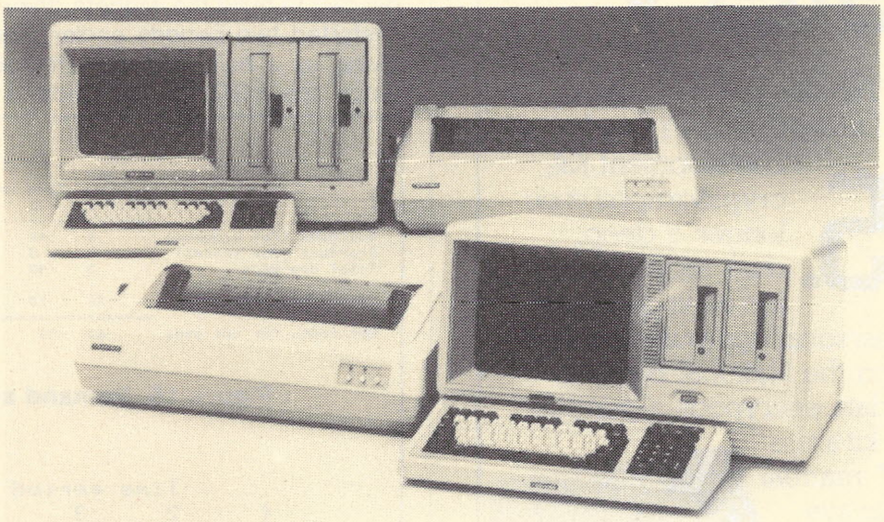

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needed to start in period 4. So another work order for 20 widgets is started in period 4.

Let's repeat the process for the doo-dads. Given the final refinement for demand for widgets shown in figure 14 and the supply factors for doo-dads in figure 10, we can create a demand schedule for doo-dads (figure 15).

Referring back to the indented bill of materials for the widget (figure 6), you can see that it takes two doo-dads to build one widget. Therefore, the gross requirements for doo-dads to be used in manufacturing widgets is twice the gross requirements for widgets.

Again, these doo-dads have a 2 period lead time, so if the five needed in period 3 are to be there when needed to build the widgets, they need to be set back —started two periods earlier than their requirement, giving us a build schedule for doo-dads (figure 16). Since the EOQ for doo-dads is 20 units, the final

	Time period 1	2	3	4	5	6
Doo-dads (for widgets)	0	40	40	40		
Doo-dads (for spares)	5	5	5	5		
Total doo-dads	5	45	45	45		
Less supply factors	70	20				
Net reqt. for doo-dads	-65	-40	5	50		

Figure 15. Demand schedule

	Time period 1	2	3	4	5	6
Doo-dads	5	50				

Figure 16. Doo-dad build schedule

	Time period 1	2	3	4	5	6
Widgets	0	20	20	20		
Doo-dads			20	40		

Figure 17. Build schedule for both types

refinement gives a build schedule that looks like figure 17 for both doo-dads and widgets.

Even for the simplest products, the calculation and construction of manufacturing schedules is a difficult task. We have left out complicating factors such as safety stock and reserved inventory. Also, the build schedule may have to be further modified, if it proves that the build requirements exceed the capacities of the work centers through which the parts are routed. This kind of shop floor loading is another feature of MRP software—highly desirable in manufacturing environments where unanticipated bottlenecks, due to insufficient work center capacity, arise frequently. □

The concluding article next month will examine the steps in processing a work order, and the pros and cons of the MRP system will be considered.

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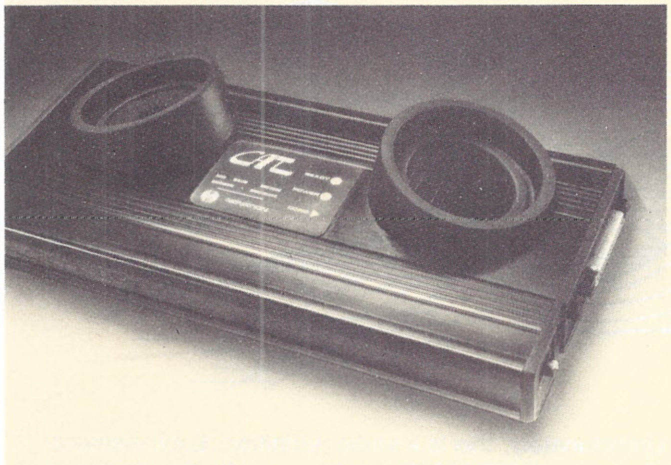

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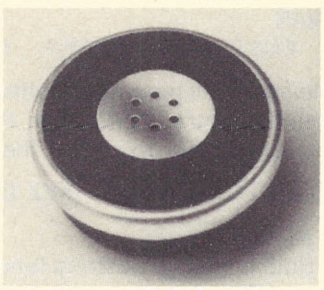

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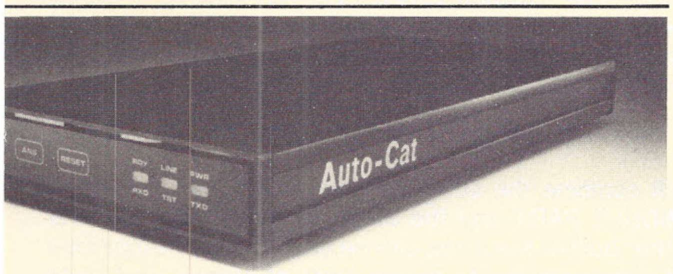

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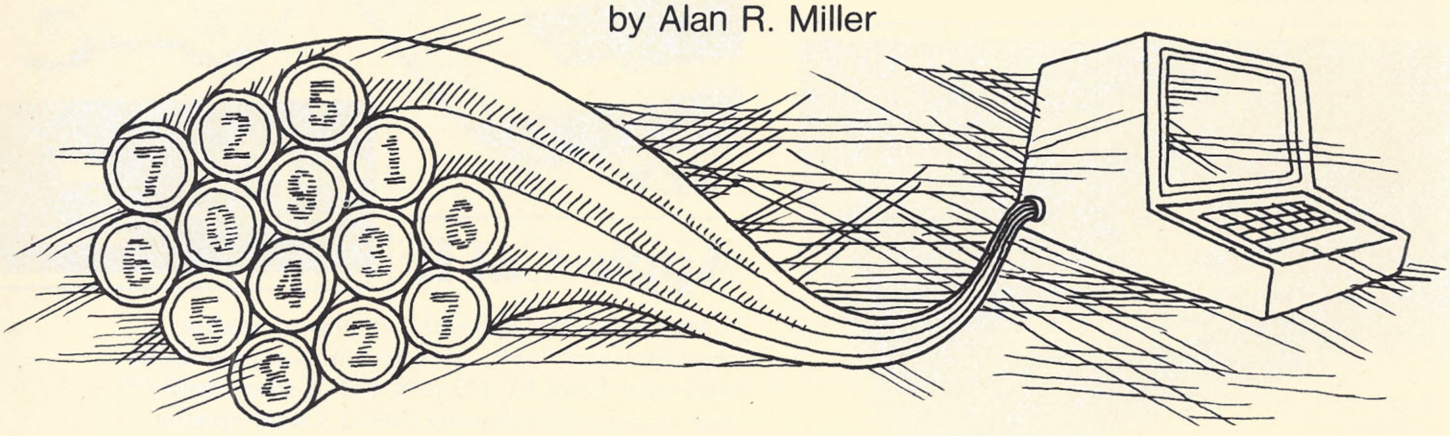
Software Review

Pascal for CP/M Sorcim's BCD Version

by Alan R. Miller



For many business and scientific computer tasks, six decimal figures of precision are sufficient. There are times, however, when more accuracy is required (for example, an inventory item costing more than $10,000).

The Fortran language provides both a single precision and a double precision representation of real numbers. Single precision is typically six figures, whereas double precision has 14 figures. Standard Basic defines only one type of real number and this is usually six-figure precision. CBasic, however, is an exception; it uses 14-figure decimal digits for all real operations. Microsoft Basic is another exception. It incorporates both a single-precision and a double-precision mode that is similar to Fortran. Standard Pascal contains a wealth of data structures such as character, set and file. Unfortunately, a double-precision representation is not included.

Several Pascals are available for CP/M. Pascal MT+ (IA Jul 81), Pascal/Z and version 3 of Pascal/M (IA Sep 80) use six-figure precision. Pascal MT+ also incorporates a fixed-point representation that carries four figures past the decimal point. This may be useful for some business applications, but it is not suitable for scientific work. JRT Pascal (IA May 81) uses 14-digit BCD arithmetic. Now there is a new version of Pascal/M, version 4 by Sorcim, San Jose, CA, incorporating 14-digit precision for all floating-point operations. It should be considered as a strong competitor to CBasic, MBasic, SBasic and Fortran for those applications requiring high precision.

Pascal/M addresses several shortcomings of standard Pascal. The string variable is one of these. String operations are common in both business and science applications. It may, for example, be necessary to update a file of names and addresses. String is not a standard Pascal data type, but it can be defined by the statements:

```
TYPE
  STRING = PACKED ARRAY[1..60] OF CHAR;
VAR
  CUSTOMER : ARRAY[1..100] OF STRING;
```

Unfortunately, this is a static definition. Each element of the array CUSTOMER must be exactly the declared length of 60 characters. Thus the statement:

```
CUSTOMER[3] := 'XYZ CORP'
```

is not allowed. By contrast, Pascal/M incorporates a dynamic string type that is very similar to that provided by Basic. In this case, a string array may be declared as:

```
VAR
  CUSTOMER : ARRAY[1..100] OF STRING;
```

The array will be packed, although the word PACKED is optional. More importantly, the array elements may be any length. For example, the statement:

```
CUSTOMER[3] := 'XYZ CORP'
```

is allowed.

Built-in Pascal/M string functions make string handling easy. The function called LENGTH can be used to determine the currently defined length of a string. String variables and elements of string arrays can be combined with the CONCAT function. For example, the statement:

```
NEWSTR := CONCAT (FIRST, ' MIDDLE PART ', LAST)
```

will combine the string variable FIRST with the string MIDDLE PART and the string variable LAST. Several other built-in functions can be used to make substrings of larger strings, to delete parts of strings, or to add characters to the middle of existing strings.

Although a random number generator is not a part of standard Pascal, it is generally awkward to use when written in Pascal. Pascal has no provisions for permanent local variables. Thus the seed is lost after each exit from the random number generator. Pascal/M solves this problem with its built-in random number generator.

The power-of-ten function is useful in both business and scientific applications. This operation is not provided in standard Pascal. Of course, powers can be computed from the exponent function. But the Pascal/M RANDOM function makes this task easier. There are

additional Pascal/M functions to read and write selected memory locations; these are similar to the Basic PEEK and POKE commands. Related functions are used to read from input ports or write to output ports. There is a special set of functions for direct cursor control on the video screen. A Pascal game called Chase is included on the disk to demonstrate this console capability.

Compilers usually make at least two passes through the user's source program. Pascal/M, however, is different; it only makes one pass. The disadvantage of this approach is that procedures (subroutines) must be shorter than about 128 bytes. This is not a serious problem, however, since good programming practice suggests that short routines are easier to understand. On the other hand, if a long procedure is needed, it can be divided into two parts, with the first part nested inside the second part. A statement, placed at the beginning of the outer, second part calls the inner part. For example:

```
PROCEDURE OUTER;
  PROCEDURE INNER;
    BEGIN (*Procedure inner*)
    . . . .
    END   (*Procedure inner*);
  . . .
BEGIN     (*Procedure outer*)
  INNER;
  . . . .
END       (*Procedure outer*);
```

The Pascal/M compiler generates a P-code intermediate file, which is then interpreted by a run-time monitor. As a result, execution time is generally slower than Pascal MT +, which generates direct binary code. In practice, however, this is not likely to be a serious problem.

With business applications, there may be frequent printing and disk activity during the execution. Consequently, the speed is limited by the peripherals. A more important consideration is the length of time needed to develop and debug the source program. This latter time is real time needed by the programmer; it requires direct intervention. On the other hand, execution can occur without supervision, perhaps even after closing hours. In this situation, Pascal/M is superior. The compiler error messages are superb. Syntax errors in the source program are usually flagged at the exact location of the problem. They can then be corrected with the system editor. As an added bonus, Pascal/M error messages are keyed to a list given in Jensen and Wirth (*Pascal User Manual and Report,* New York, Heidelberg, and Berlin: Springer-Verlag, 1974).

The Pascal/M compiler, like other Pascal compilers, is very large. The CP/M system should be at least 56K in size. The compiler works from a source file previously placed on the disk. However, Pascal/M contains an Include option. Frequently used portions can be placed into separate disk files and referenced from the main program. Suppose, for example, that a sorting procedure is placed in a disk file called SORT.PAS, and a plotting procedure is placed in another file named PLOT.PAS. Then the statements:

```
(*$F SORT.PAS *)
(*$F PLOT.PAS *)
```

can be placed in the main program to reference these two procedures. The resulting P-code file will be the

same as if these two procedures were actually placed in the main program.

There are several other compiler directives that can be embedded into the source program. Selected portions of the source program can be listed by turning on or off the listing option with the L command; a new page can be obtained with the P command. These directives are embedded in Pascal comment symbols just like the INCLUDE directive.

There are several options that can be specified at compile time. One of these allows the compiling of very large programs. In this case, the S (for swap) option is given. Pascal/M will then overlay some of its routines. The result is a saving of computer memory space at the expense of execution time. Another compile-time option can be used to list the source file on the console or printer. Another option will generate a separate file for later debugging. Yet another directive allows a quick syntax check of the source program by suppressing the generation of the P-code file.

File handling is relatively easy. As an example, the Pascal/M source program given in the listing can be used to sort a disk file of ASCII records (i.e., lines of data). When the program is executed, it asks for the name of the original file, then the name of the new file. The records, which do not have to be blocked (i.e., equal length), are read into the array REC. They are then arranged in increasing order with a recursive quick-sort procedure. This sorting algorithm is one of the fastest. However, it cannot be directly translated into Fortran or Basic since it is recursive; that is, it calls itself.

After the records have been sorted, the array is written to the new disk file. Several checks are made during execution of the program. If the source file does not exist or if a blank name is entered, the file name is requested again. If the destination file name is the same as the source file name, it too is requested again. If the destination file cannot be closed, an error message is printed. Otherwise, the total number of records in the file is printed. This sorting program can be used to sort integers or real numbers by redefining SORTEL and ARY as integer or real variables.

With the addition of 14-digit floating-point arithmetic, version 4 becomes a very desirable package. □

A Pascal Program to Sort ASCII Records

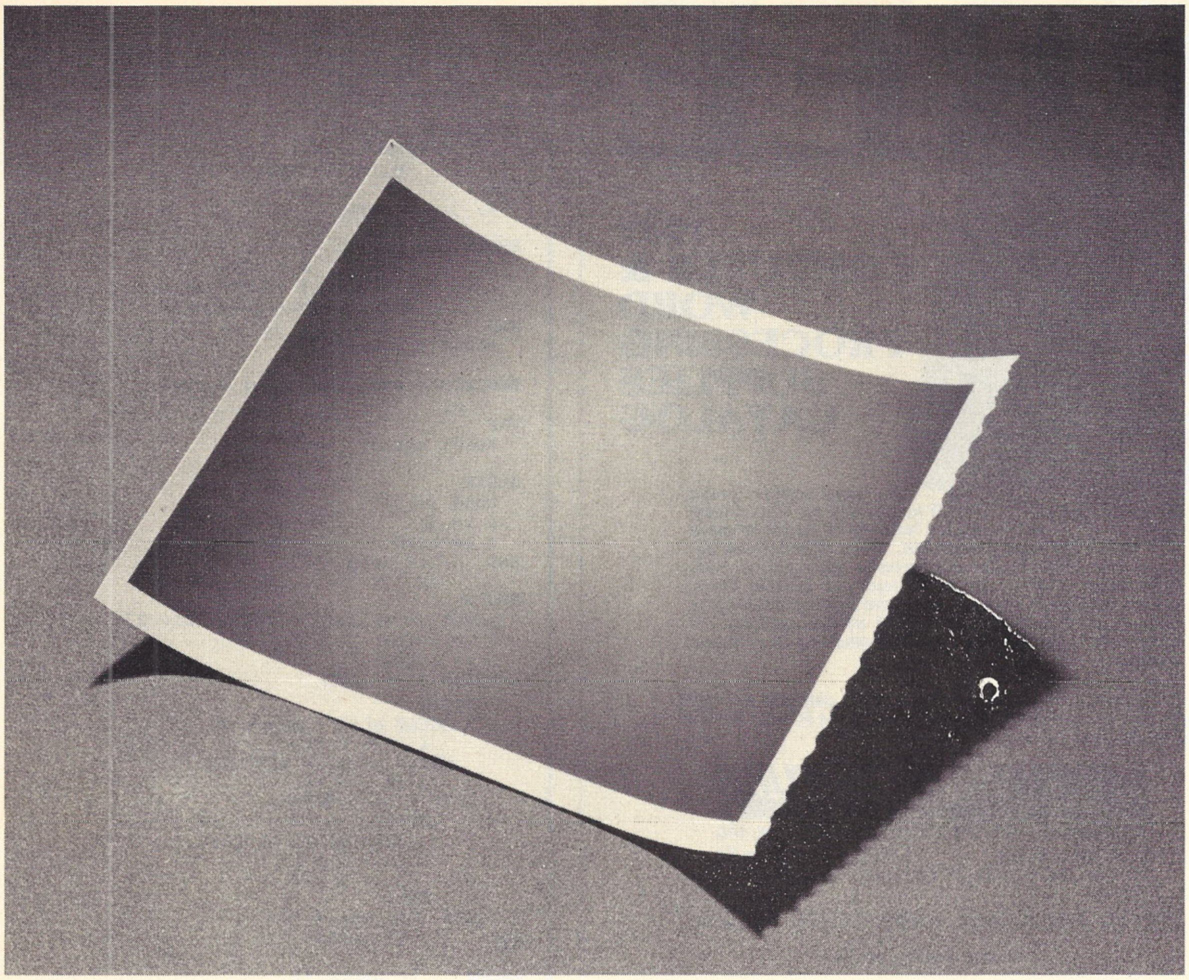
```
PROGRAM fsort(infile, outfile, input, output);

 (* Pascal program to sort a disk file INFILE
    and save the result as separate disk file
    OUTFILE. The file consists of ASCII records. *)

TYPE
  sortel = string;
  ary = ARRAY[1..150] OF string;

VAR
  count, total: integer;
  infile, outfile: text;
  inname, outname: string;
  rec: ary;

PROCEDURE (* quick *) sort
        (VAR x   : ary;
             n   : integer);
```



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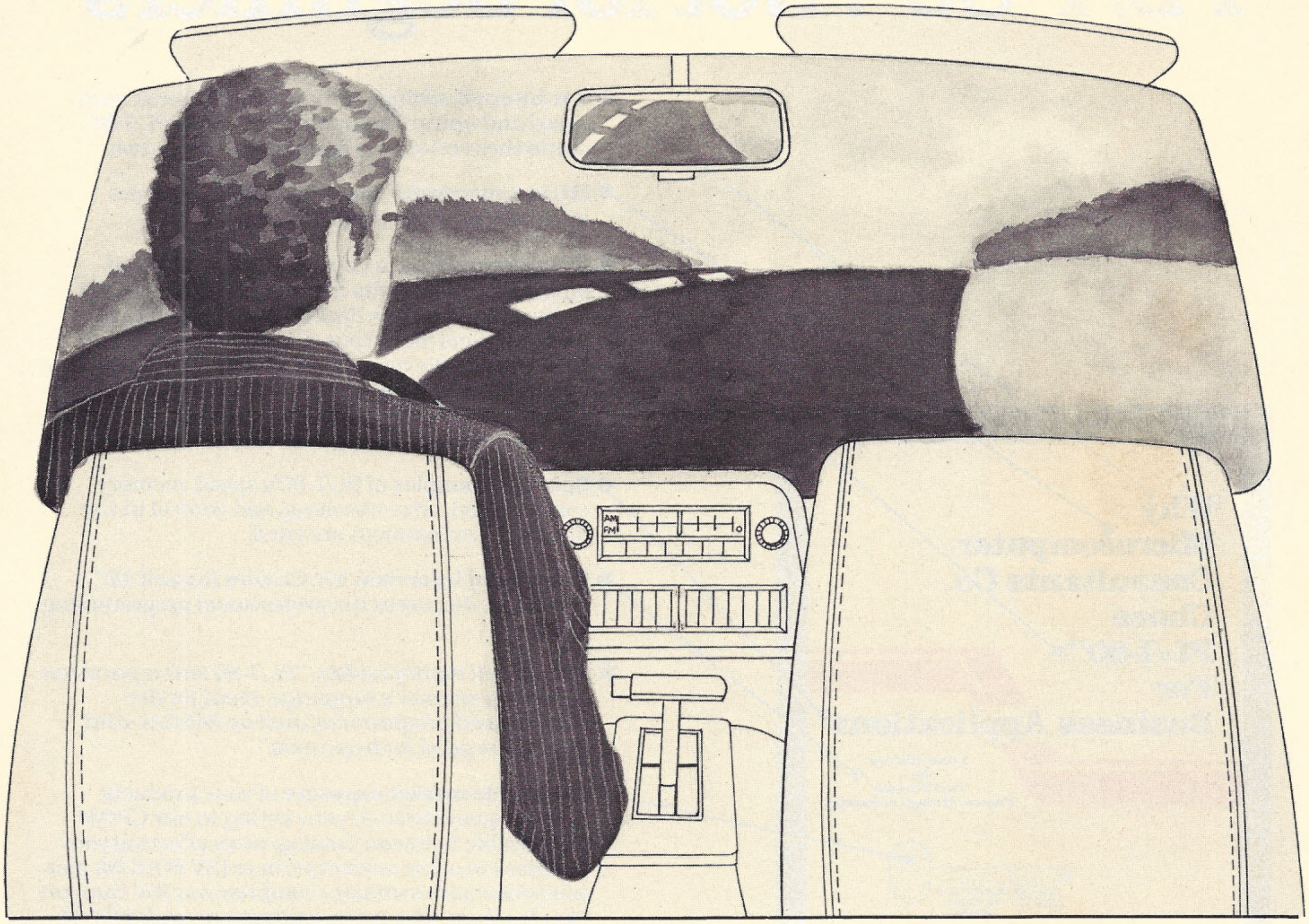
```
  (* a recursive sorting routine *)
  (* From A. R. Miller, Pascal Programs
     for Scientists and Engineers,
     Sybex, 1981 *)

PROCEDURE qsort
        (VAR x: ary;
          m, n: integer);
VAR
  i, j: integer;

PROCEDURE partit
          (VAR    a : ary;
           VAR i, j : integer;
         left, right: integer);
VAR
  pivot : sortel;

PROCEDURE swap(VAR p, q: sortel);

VAR
  hold: sortel;

BEGIN
  hold := p;
  p := q;
  q := hold
END     (* swap *);

BEGIN
  pivot := a[(left + right) DIV 2];
  i := left;
  j := right;
  WHILE i <= j DO
    BEGIN
      WHILE a[i] < pivot DO
        i := i + 1;
      WHILE pivot < a[j] DO
        j := j - 1;
      IF i <= j THEN
        BEGIN
          swap(a[i], a[j]);
          i := i + 1;
          j := j - 1
        END
    END   (* while *)
END       (* partit *);

BEGIN    (* qsort *)
  IF m < n THEN
    BEGIN
      partit(x, i, j, m, n) (* divide in two *);
      qsort(x, m, j)    (* sort left part  *);
      qsort(x, i, n)     (* sort right part *)
    END
END        (* qsort *);

BEGIN  (* sort *)
  qsort(x, 1, n)
END   (* sort *);

BEGIN   (* main program *)
  REPEAT
    REPEAT
      write(' Name of file to be sorted: ');
      readln(inname)
    UNTIL inname <> '' (* not blank *);
    reset(infile, inname)
  UNTIL not eof(infile);
  REPEAT
    write(' Name of new file: ');
    readln(outname);
    IF outname = inname THEN
      BEGIN
        writeln('WARNING: both names are the same');
        outname := ''   (* get another name *)
      END
  UNTIL outname <> '' (* not blank *);
  purge(outname)    (* erase existing name *);
  rewrite(outfile, outname);
  count := 0;
  WHILE not eof(infile) DO
    BEGIN     (* read original file *)
      count := count + 1;
      readln(infile, rec[count])
    END;
  total := count;
  sort(rec, total);
  FOR count := 1 TO total DO  (* write new file *)

    writeln(outfile, rec[count]);
  close(outfile);
  IF eof(outfile) THEN
    writeln(total, ' records written to new file')
  ELSE
    writeln(' ERROR: File not closed')
END.
```



THE POCKET COMPUTER AS A TRAVEL GUIDE

by David D. Busch

If you own an automobile built after 1977, chances are good that there is some sort of microprocessor deep within the recesses of your engine bay, quietly calculating ignition timing, fuel injection, or some other function. In addition, many of us have factory-installed or "aftermarket" trip computers that monitor gasoline consumption, average speed, estimated time of arrival, and other variables.

It seems certain that most cars will soon have microprocessors that monitor maintenance items and unfastened seatbelts. Others will tell us the best route from point A to point B. Since the computer invasion of the automobile is well underway, why not surrender early, and put your pocket computer to maximum use on long trips?

Autocomp was written for the Sharp/TRS-80 pocket computer, but I've purposely avoided using most of the model's special features in order to make it adaptable to a wide variety of handheld calculators/computers. So, you won't find a liberal use of BEEP or PAUSE here.

Important Variables Used in Autocomp

A$	Menu choice selected by user.
B	Initial odometer reading at start of trip.
C$	Update or use same data choice.
D	Miles to destination at start of trip.
E	Distance which can be travelled on remaining gas.
F	Update or use same data flag.
H	Starting hour, 24-hour format.
I	Gallons used from current tank of gas.
J	Stores capacity of gas tank.
K	Gallons put in to fill tank.
L	MPG, either estimated, or calculated.
M	Starting minutes.
O	Current odometer reading.
P	ETA
Q	Odometer reading at last fillup.
R	Gallons of gasoline remaining in tank.
S	Miles travelled since last fillup.
T	Average miles per hour for trip.
U	Miles travelled on trip so far.
V	Gas tank capacity.
W	Start minutes minus current minutes.
X	Current hour.
Y	Number of hours travelled so far.
Z	Current minutes

Instead, the program will accept input from the user as to current odometer reading, time, number of gallons of gas put in, and compare them with starting figures or the next most recent updated information. It then can calculate ETA, average MPH for the trip, most recent MPG obtained, approximate number of gallons of gas remaining, and about how many miles can be traveled (given current MPG) before running out of fuel.

Because the pocket computers retain their data when the unit is turned off, the program can be entered once, and then used from time to time during a long trip. If a cassette interface is available, the program may be sorted and loaded as needed to allow access to other programs. You might also consider renumbering it so that additional short programs can be stored in the pocket computer's memory and accessed via GOTOs or defined keys.

Bypassing the initialization

An initialization routine is included in lines 10-90. This can be used at the beginning of the trip, and then bypassed on each subsequent access by typing GOTO 120, or by entering SHFT A. For those not familiar with the pocket computer's operation, the unit recognizes labels as well as line numbers for GOTO-type operations. The A in line 120 labels that module so the user may use the reserved A key to start the program at that point without reinitializing the variables that may have been set or updated in previous runs of Autocomp.

To first use the program on a trip, type RUN, and then enter the capacity of your vehicle's fuel tank, a rough estimate of the MPG you can expect from the first part of the trip, and the current time. No sophisticated timekeeping module was used, in order to keep the size of the program down. Simply enter the current hour in 24-hour format. That is, 1 p.m. is 13, while 11 p.m. is 23. Minutes are entered normally. No error trap is included to filter out ridiculous time entries (i.e., more than 23 hours, 59 minutes, or more than 59 minutes to an hour). You are free to add one if you choose. It simply seemed more reasonable to expect the operator to know how to tell time.

After the starting odometer reading on the vehicle has been entered, a menu appears that asks which function is desired:

(E)TA (M)PG (A)VG. MPH (G)AL

Only the first letter of a choice should be entered, and these correspond to the estimated time of arrival, miles per gallon or most recent fillup of gas, average miles per hour for entire trip, and gallons of gas remaining until empty. If input does not correspond to the legal choices, the program branches back to the menu to give the user another crack at it. Otherwise, control drops down to one of four appropriate subroutines.

In each of these, the program can display a calculation based upon the most recent input of data, or figure new totals from updated information. This choice is flagged in line 140, and the result stored in the variable F, which is compared at appropriate points for a status of 1 or 0.

To calculate ETA, the user inputs current time and odometer reading, and is shown miles traveled and the estimated hour of arrival. The program will notice if the ETA extends beyond one day (that is, is greater than 24), and will make a correction to show the correct time. It will not figure ETAs longer than one day ahead for practical reasons: while we may arrive after midnight, few of us ever drive for more than a day straight.

Average miles per hour for the trip is calculated from the same data, and is displayed in whole MPH, with the fractions rounded off.

To figure MPG, the program assumes that the user began the trip with a full tank of gas and fills up at each opportunity. If you do add a partial tank of gas, simply record the number of gallons used, and add these to the total the next time you do fill up. Refrain from attempting to calculate a new MPG until you top off the tank.

Each time the tank is filled up, the current odometer reading is entered into variable O, and then the odometer reading at the last fillup, Q, is subtracted from that to determine miles traveled in K gallons of gas. Then, the current reading is transferred to Q for use next time (line 550).

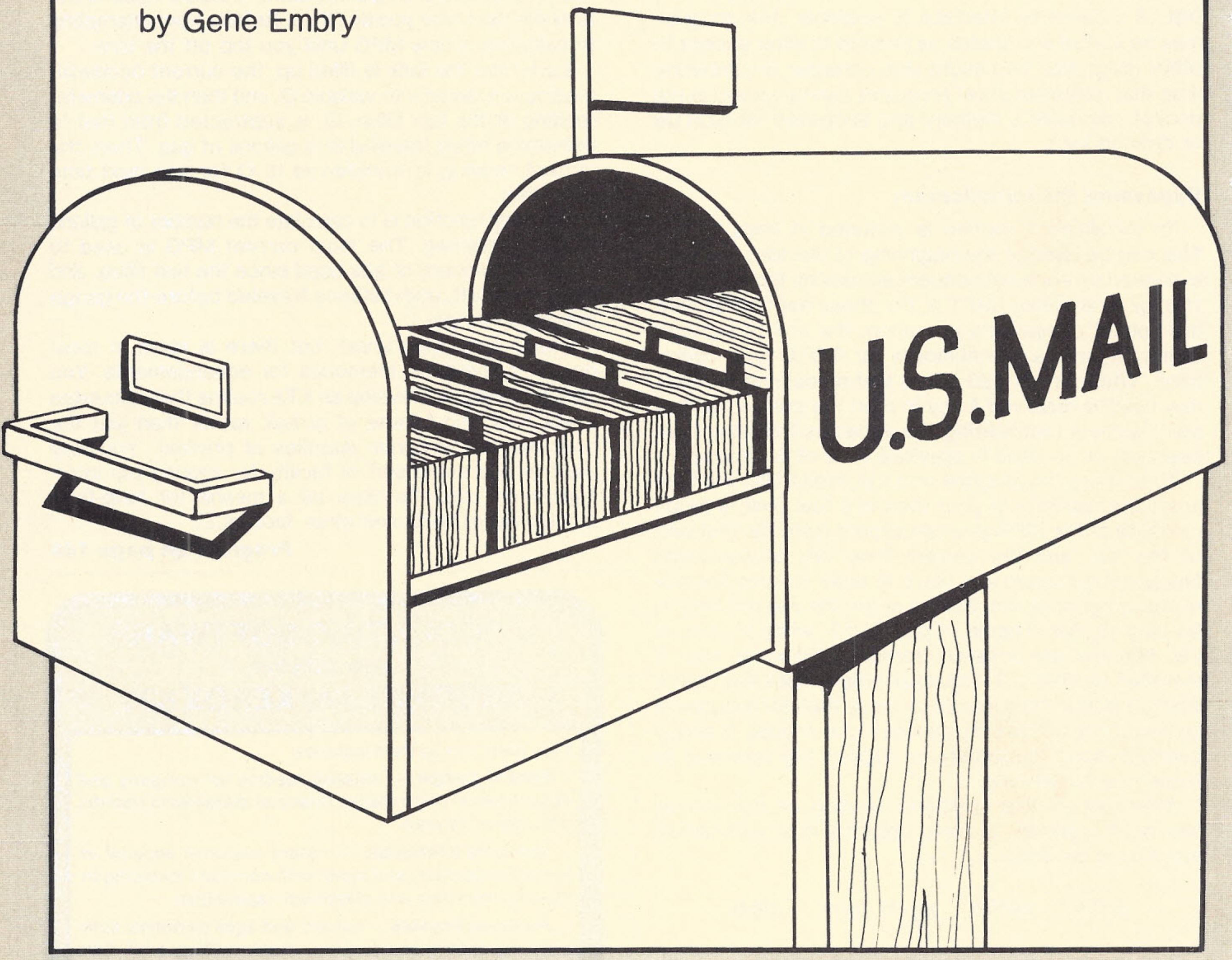
The final function is to calculate the number of gallons of gas remaining. The most current MPG is used to figure the amount of gas used since the last fillup, and the gallons left, and distance traveled before the gauge indicates "empty."

I kept Autocomp short, but there is room in most pocket computers' memories for enhancements. You can, for example, develop an ETA routine that calculates exact hour and minute of arrival, rather than just the hour that the program supplies at present. You may want to add some sort of facility for storing trip information on cassette tape as a means for long-term monitoring of MPG and other factors. □

Program on page 146

Sort-Purge-Merge Program

by Gene Embry



The use of a high level language, such as Basic, to sort a large data base presents a number of problems to the user of a microcomputer system. Ideally, you would like to be able to read the entire data base into memory and then manipulate it. The problems are related to the language and the amount of read/write memory available in the sytem. Generally, the language will limit the size of the data array to 255 elements. If larger arrays were available, then very quickly you would exceed the memory available in the computer.

A need recently arose to sort by zip code several large mail lists. By large we mean in excess of 1,000 records. Initially we did a Shell Metzner sort directly on the data file. It worked, but the time was too long and the disk drives had to move constantly.

The program requires about 40 minutes to execute on my machine using 1,000 randomly generated zip codes. If you load this program, along with the comments, you will need about 4,500 bytes of memory. Program variables require another 4,500 or so bytes. The exact number will be a function of the size of strings, the number of bytes required per open data file and other parameters. Thus, it will fit nicely in almost any small business system.

Each record of the mail list data base consists of five fields. The variables of each record are as follows:

A$ = Name
B$ = First Address
C$ = Second Address
D$ = City and State
A = Zip Code

The programs that permit additions, deletions, modifications and label printing will not be discussed here. It

should be mentioned that a deletion of a record is made by storing an empty string (A$ = " ") in the Name field.

The system we use is a SWTPC-6800 computer with 48K of RAM. The dual 8-in. floppy disk is from Smoke Signal Broadcasting Co. Each single sided, single density disk formats with about 250,000 bytes of storage. The Disk Operating System (DOS) is Smoke Signal Broadcasting, version 5.1. The high level language is Computerware's Random Basic, version 8.5.

Four programs are given.

Listing 1 — SORTML.ZIP
Listing 2 — CREATE.ML
Listing 3 — READ.ML
Listing 4 — FILL.ML

The first listing is the main program. The second program is used to CREATE two files that may be used to test SORTML.ZIP. The third program will read data that is in the random data file MAIL.DAT. The fourth program may be used to fill the data file with real 5-digit zip codes.

In addition to the main data file, MAIL.DAT, there is a sequential data file associated with it. This file, INFORM.DAT, presently contains six numerics. The first is used to indicate how many records have been written to in MAIL.DAT. The second is used as a sort flag. If it is zero, then no sort is needed. The rest are spares, but might be used to store information regarding the ID number of the disk, the last time it was modified, the number of empty records or other information.

The main program runs from line number 1 to 999 with calls made to various subroutines along the way. The colon and double colon are used to indicate REMarks. The very generous use of comments will make it easy to modify the program next year. I try to start each major section of code with line numbers evenly divisable by 100. All subroutines RETURN on line XX90.

As the program executes, you will be informed on the status of each section of the program. The program is limited to 1,530 records in MAIL.DAT. If a larger data base is required, then you must add to the 4000 section of the program and increase the size of the subscripted variables, Z( ) and R( ) via line number 12.

Lines 1 to 99 inform you what the program is about and allow you the chance to abort. They then open two files, MAIL.DAT and INFORM.DAT, and will terminate automatically if the file, MAIL.DAT, does not need to be sorted.

Determining number of sorts

The first of two calls in lines 100 to 199 is made to subroutine 4000, which determines the number of times, S, we will need to sort. This is based on the number of records stored in MAIL.DAT. This number, S, is also the number of sequential files we will need.

In lines 200 to 299, the filing, sorting and saving of each element in array S(255,2) is done with calls to three subroutines—1000, 2000 and 3000. The comments in lines 1000 to 1090 should be sufficient to understand the filing process. A call to routine 5000 is made in line 1040. This is where you might purge your data file. Any data you want excluded or included in the new file should be tested here. The flag, F1, should be set to a non-zero number if you want the data included in the sorted data. The actual sort is done by the call to subroutine 2000. I have used my favorite sorting technique, Shell-Metzner, but use any you might like to substitute. The array S(X1,2) is saved in a sequential file name "SEQ" + STR$(F) by calling routine 3000, where F is the current value of the loop being served in the FOR-NEXT loop of lines 200 to 299.

Following the sorting section, we report on the number of records purged. A second call to routine 4000 is made in line 280 to reestablish the actual number of sequential files needed to hold our data. For example, if we initially had 900 names in MAIL.DAT, then the first call to 4000 would return a value of 4 for S. If we only selected 500 names, then the second call to 4000 would return a value of 2 for S. This second call is a must, due to the way we handle the merge section.

Two categories of file

Let us summarize at this point. We now have two random data files that are equal in size (R). Both have the same name (MAIL.DAT) but are on different drives. Disk B (right) has the original unsorted file. Disk A (left) contains the empty file, MAIL.DAT. On disk A we have some sequential (serial) data files. Each record of each file has two numbers. The first number is the zip code and the second number is the record pointer to the file MAIL.DAT on drive B. Further, each serial file is sorted by zip code. The number of serial data files is equal to S, as determined by routine 4000. All contain 255 records with the possible exception of the last one.

With lines 300 to 399, the merge section starts by calling section 7000. This routine performs two tasks. First, it opens the temporary data file MAIL.DAT on disk A. This file will hold the sorted mail list. Second, it opens all the sequential data files created under the sort part of the program. It then reads the first record from each serial file and stores the two pieces of data in the subscripted variables, Z(X) (zip code) and R(X) (record pointer).

A call is then made to routine 7100, which will look at each of the current zip codes, Z(X), to find the smallest one. When the smallest one is found, it calls subroutine 7200, which uses the record pointer, R(L1), to get the record from MAIL.DAT on drive B and saves (puts) it in MAIL.DAT on drive A. Then the next record of that serial file is brought up into Z(L1) and R(L1). If the end-of-the-file is read, the value of Z(L1) is set to 999999. Upon returning to section 7100, the program continues to loop until all records in all serial files have been read as indicated by L2 being incremented to equal the number of serial data files we needed to merge. At this point, the return is made to the main program.

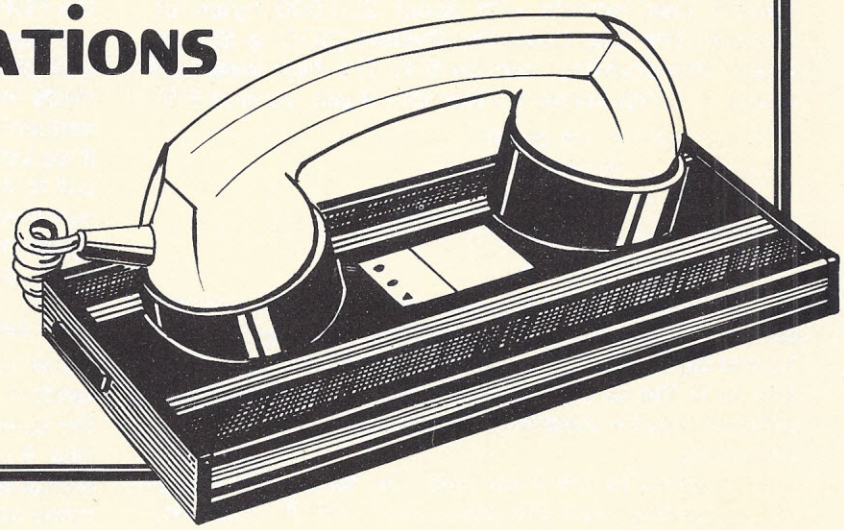
The remaining portion of the program, lines 400 to 999, transfers the sorted data back to drive B, deletes the serial files, updates INFORM.DAT and reports the final status of the mail list file.

On my system, the following time studies were observed after generating 1024 records via program CREATE.ML. It took about 60 seconds to fill each S(255,2) array and then required another 177 seconds to sort each full array. Saving the array required another 18 seconds. The merge section took 911 seconds. The transfer from disk A to B required about 6 minutes and 40 seconds. You may, of course, delete the coding from 600 to 699 and use DOS to transfer from A to B and save a considerable amount of time. □

Program on page 148

Gaining Telecommunications Control

by Gene Cotton



Two similar problems that occur periodically when dealing with microcomputers are the need to use a large timesharing service, and the need to talk to another microcomputer. If you are using an 8080 compatible CP/M disk system, you already possess most of the required hardware and software to allow your system to simulate an intelligent terminal. In addition to your normal CP/M system, you will need an acoustical coupled modem and an RS-232 serial port.

If your system has a spare serial port or if you wish to use the printer port, the only additional hardware needed is an acoustical coupled modem. I use a Livermore Data Systems 300 baud model 71A modem. Any similar modem should function as well. However, the baud rates of the modem and the serial port must be the same.

If the serial port is not configured for a modem, the data in/out wires (pins 2 and 3 of the RS-232 plug) will have to be cross-connected. This is usually constructed from two male 25-pin connectors and three wires. The signal ground (pin 7) is wired together between the two connectors. The data-in (pin 3) of one connector is then wired to the data-out (pin 2) of the other connector.

How such a modem interacts with the microcomputer is dependent upon the program used to control the actions of both the modem and the microcomputer. Let's examine the design of such a program and its use in the CP/M environment. The accompanying listing is intended to introduce some of the techniques that can be used in the area of data communication.

To provide the easiest possible use, the program should be a CP/M ".COM" file. This will be accomplished by coding the program in 8080 assembly language and using the assembler provided in CP/M. The program will be designed to allow your system to act as a terminal to either a remote host computer (like a timesharing service), or another microcomputer user who also has the terminal program running.

The program will have the ability to transmit a CP/M file and to receive data into CP/M files. Since the terminal program buffers modem input into memory during a "RECEIVE" command, memory requirements will vary with the largest file you wish to receive. The terminal program will "SEND" or "RECEIVE" CP/M disk files from either disk drive A or B.

Experience has suggested that the console device should be at least twice as fast as the modem. The program has been used with both a 9600 baud console and a fast video board. It was developed on a system using 8-in. floppy disk drives. The modem used in development was an originate-only modem. To communicate with another microcomputer user, at least one of them must have a modem with answer mode capability.

In order to act as a terminal, the program traps all input both from the console and the modem and determines which information is sent to the console and which is sent to the modem. All input typed at the local keyboard is sent to the modem (and optionally echoed to the local console). All input from the modem is sent to the local output. All input/output may optionally be printed by the local list device.

In addition to console and modem, the program maintains a file buffer that is either receiving modem data or supplying data for the modem. Control of the special features is by a command mode character. While in the command mode, the modem will not be able to input or output any information.

To execute the terminal program, enter the CP/M CCP and type:

A>TERMINAL

After the terminal program has loaded, it will respond with:

Terminal Program - Version 2.0

After the phone has been answered or you have dialed a number and established a connection, the program simply acts as a go-between for your machine and whatever is on the other end of the phone connection.

At this point you are a terminal. Anything typed at your console is sent to the modem. Anything received from the modem is typed to your console. Control characters will be typed at your console as "^X", where "^" indicates a control character and "X" is the uppercase letter, which (when typed with the control key held down) produces this character. The NULL (hex 00) is ignored as input from the modem and will

not be passed to the terminal program. Certain control characters will be typed as is, since they have special functions. They are CR (carriage return), LF (linefeed), TAB and BS (backspace).

You have certain commands available at your console (that are not sent to the modem). Commands are control sequences, which prompt with a "?" if not understood, or complete the command word(s) when the command is valid.

Commands are entered by typing a special function key (make sure it is not used otherwise). The ^@ (control @ is the NULL character) is assumed for the purpose of this discussion. After the command key is pressed, the prompt line,

>>Close, Speed, Echo, Linefeed, Print, Quit, Receive, Send, Uppercase>>

is displayed. Typing the first letter of any command causes the remainder of the command to be displayed and the appropriate action is taken. The command lines are not sent to the modem.

The commands are:

C Close Files
D Delay Factor Bumped By One
E Echo Toggle Switch & Auto Linefeed
L Automatic linefeed after carriage return
P Print Toggle Switch
Q Quit and Return to CP/M
R Receive Data into CP/M File
S Send a CP/M Text File
U Uppercase Lock Toggle Switch

The expanded explanations of each command follow.

C (^@C)(LOSE FILES)

This command closes any open files. It is used to interrupt "SEND" or "RECEIVE" commands and force the open file closed. "RECEIVE" files are written from the memory buffer to the disk file before closing.

D (^@D)(ELAY FACTOR BUMPED BY ONE)

This represents the amount of time delay after a carriage return and line feed is increased each time this command is invoked. The delay is needed by some systems in order to process the line just sent. The delay needed in each instance is found by trial and error.

E (^@E)(CHO TOGGLE)

This indicates whether the echo toggle switch is on/off. Echo switch "on" sends any output character to the local console, as well as the modem for transmission. This feature is useful when the computer with which you are communicating doesn't echo characters (i.e., is operating in the half duplex mode). This simulates half duplex in the terminal. It is also needed when talking to another microcomputer that uses the same terminal program, to see what is being sent as well as received.

L (^@L)(INEFEED (automatic) TOGGLE)

When on, this command generates a linefeed after each carriage return. It is inactive when the terminal program is initially called.

P (^@P)(RINT TOGGLE)

This indicates whether the print toggle switch is on/off. When the print switch is on, any character going to the local terminal output is also sent to the CP/M list device. This feature allows remote files to be printed locally.

Q (^@Q)(UIT)

This enables you to quit the program. Control is passed to the CP/M unless a file is open. Any open files are closed before control is returned to CP/M. Unclosed "RECEIVE" files are written to the disk before closing.

R (^@R)(ECEIVE [<disk>:]<filename>[.<ext>])

This allows you to receive input from the modem and write it out to a CP/M file. All incoming data is buffered in memory until an eof (^Z) is detected in the input stream. The memory buffer is written to the CP/M file after the eof is detected. The file may have any extension, but is assumed to be text (.ASM, .BAS, .DOC, etc.). The file may be written to either drive A or B. If the file does not exist, it is created. If the file exists, it is overwritten, and any previous information is overwritten. The "d:filename.ext" is converted to uppercase before it is used. If the file does not close automatically, or if it becomes necessary to close it early, you may issue the "CLOSE" command. Because the incoming data is buffered into memory and automatically stops at the end of available memory, large files will have to be broken up into two or more smaller files for transmission. Buffering became a requirement when it was discovered that not all host computers have handshaking capabilities.

S (^@S)(END [<disk>:]<filename>[.<ext>])

This enables you to send a CP/M file to the modem until an eof (^Z) is detected in the sending file. It assumes the file to be sent is a text file. The file may be on either drive A or B. The "d:filename.ext" is converted to uppercase before it is used. This command may be aborted early by the "CLOSE" command.

U (^@U)(PPER CASE TOGGLE)

This toggles the uppercase lock switch on/off. When the switch is on, all lowercase input from the console is converted to upper case before being processed.

After the program was in use for some time, it became obvious that the modem was not really required if two microcomputers were physically close enough to be cabled together. The serial ports to the modems can be connected together. There are some problems to be recognized.

The cable connecting the two must swap the data in and data out lines. The simplest of all connecting cables uses only three wires. On a standard RS-232 connector, pins 2 and 3 are the data lines and pin 7 is used for signal ground. The two ends of the cable are wired with pin 7 connected to pin 7, but pin 2 of one end is connected to pin 3 of the other end.

Since the modem is not in the middle, it is no longer required to set the baud rate at 300. It is important that the two computers be set at the same baud rate. It will also be difficult to echo at the receiving computer if the baud rate is high. If the sending computer echoes and the receiving computer does not, that will generally slow the process enough to correct any problems. By manipulating the delay command, the best sending speed can be found without changing the baud rates. If all else fails, slow the baud rates until reliable transfers occur.

Files that are not in text format will terminate transfer at the first occurrence of a hex 1A. If .COM files are to be transferred, it is best to UNLOAD them and send the .HEX files. □

Program on page 152

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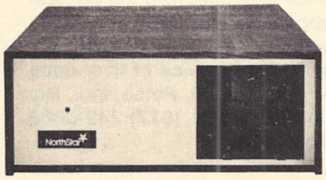

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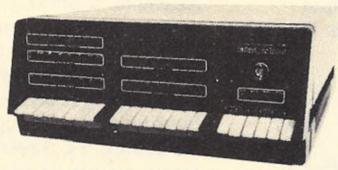

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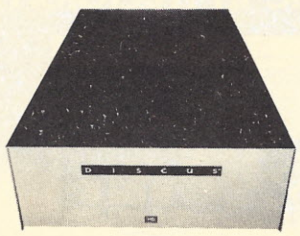

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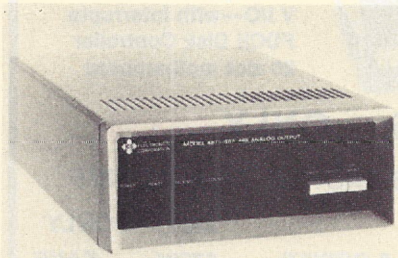
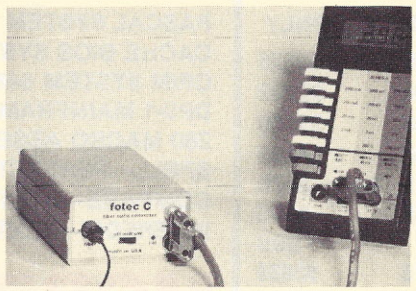


separate, user-selectable output-signal ranges available per channel: 0 to +10 V, −10 to +10 V, or −4 to −20 mA. The analog output channels are isolated from the bus itself as well as from the 4871's internal logic; this provides a low-noise environment for system applications. Price: $1,295. ICS Electronics Corp., 1620 Zanker Rd., San Jose, CA 95112, (408) 298-4844.
CIRCLE INQUIRY NO. 220

Bipolar PROM, the HM-76641, is a monolithic device, utilizing the same basic process technology as the Harris HM-76161 16K PROM. The 64K PROM is in an 8K word by 8 bit/word format, currently available in a 24-pin dip. It has a TAA (address access time) of 85 nsec maximum. It offers a four-fold increase in memory size over currently available 16K PROMs in the same 24-pin package and with approximately one fourth of the power dissipation per bit. Harris Corp., Semiconductor Group, P.O. Box 883, Melbourne, FL 32901, (305) 724-7800.
CIRCLE INQUIRY NO. 221

Fiber optic instrument, the Fotec C fiber optic convertor, converts standard multimeters into fiber optic power meters. It

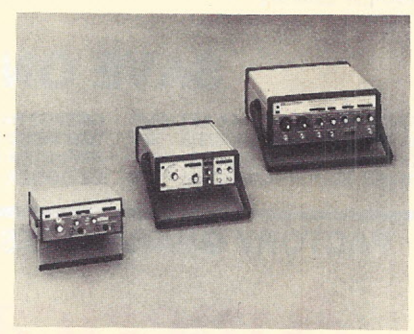


can be used with any multimeter or voltmeter to measure basic fiber optic system parameters such as fiber attenuation, connector or splice loss, source power coupled into fibers, or signal level at the receiver. While designed with the requirements of laboratory fiber optic measurements as a guide, the instrument is also ideal for field service of fiber optic installations. Price: $250. Fotec, Inc., Box 246, Boston, MA 02129, (617) 242-0863.
CIRCLE INQUIRY NO. 222

Portable bit finder can examine I/O or display the data read from or written to any byte of memory within the address range of the microprocessor. The module works by simply replacing the CPU and setting the switches to the desired address. Any data written to that I/O or

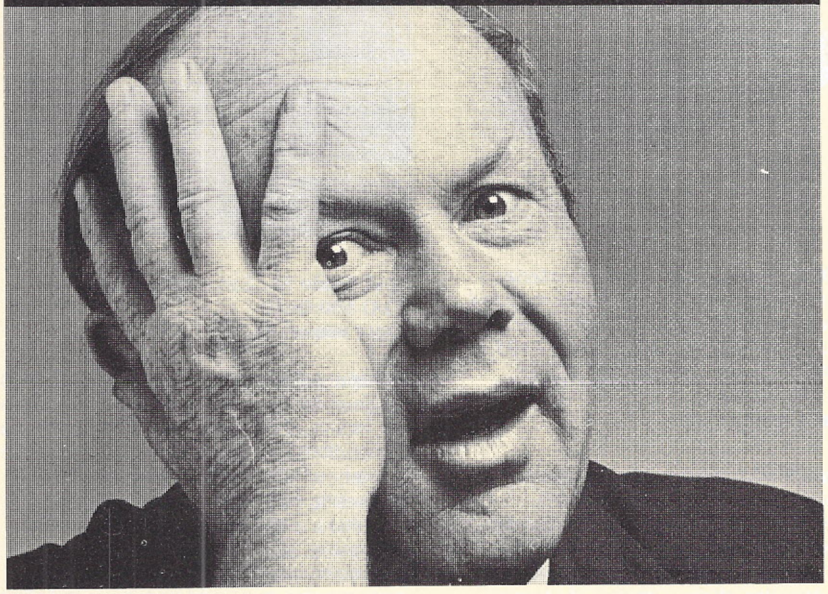
address will be displayed in eight LEDs. Separate switches allow the user to select read or write, or both. Available for CPUs Z80, 6502, 6512, 6809, 6800, 6802, 8080, 8085. Modules to fit other CPUs are available on special order. Price: $125. CTC Electronics Corp., 11724 W. Olympic Blvd., Los Angeles, CA 90064.
CIRCLE INQUIRY NO. 223

Function generators, the models 3030, 3025 and 3015, provide frequency coverage from .001Hz to 5MHz in eight ranges. Dial frequency accuracy is ± (1% rdg + 1% fs) up to 1MHz. Sine wave distortion is less than 0.5% from 1Hz to 100kHz. For highest accuracy, Kelvin-Varley dividers are used as start/stop controls to set the low and high end limits



of the desired frequency sweep. Sweep times are also selectable, from 10 mS to 100 seconds. Control over linear or logarithmic sweep operation is provided by a front-panel pushbutton. The 3030 may

"You could have knocked me over with a feather...



...when I saw all of the stock and commodity studies, charts and detailed history a small Apple™ computer could do using TAG programs. The computer dialed a data bank, collected prices on 50 items, then—unattended—turned out 30 pages of charts and graphic studies. It did all this while its owner and I had a cup of coffee. Truly amazing!"

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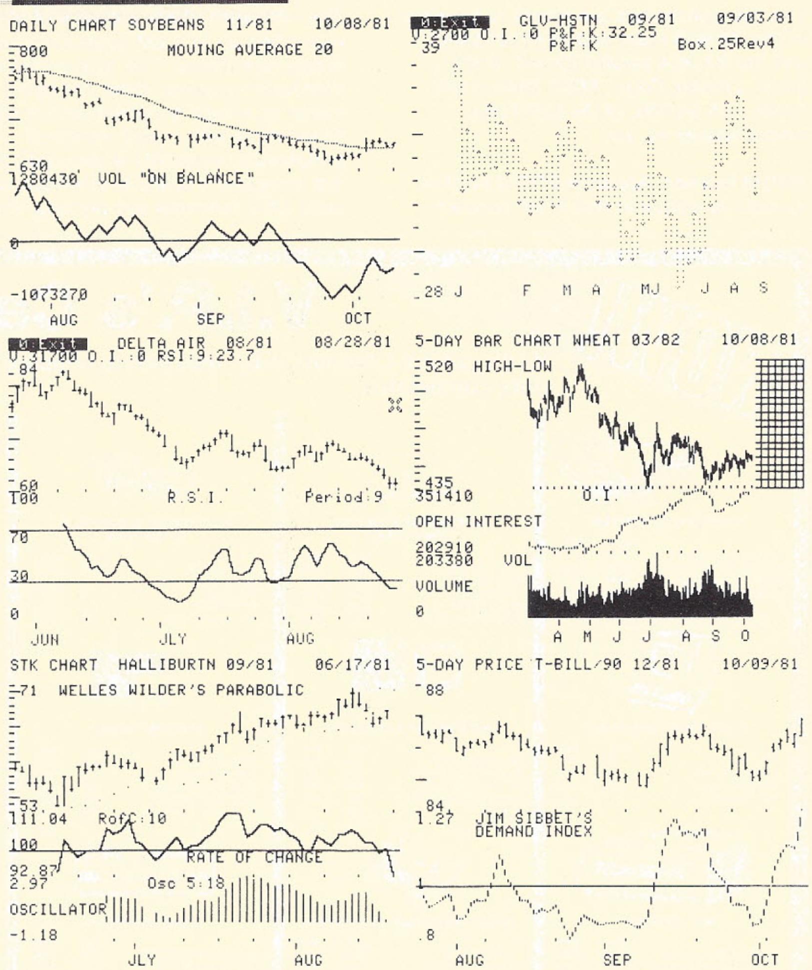

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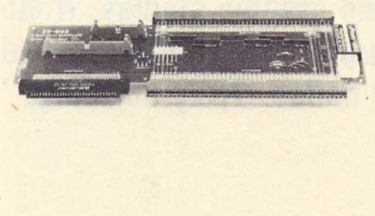
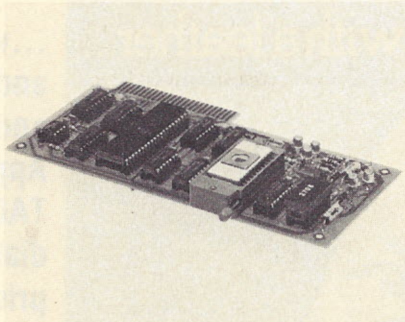
also be externally swept by applying a 0.5 volt ramp signal to the VCF input. B&K Precision Product Group, Dynascan Corp., 6460 W. Cortland Ave., Chicago, IL 60635, (312) 889-9087.
CIRCLE INQUIRY NO. 224

Flatbus, the ZX-602, is a two-slot implementation of the multibus. It allows any two multibus cards to be connected together to form a powerful two card system that can be panel-mounted in a space no more than two inches thick. Two additional mass terminating connectors are provided on the



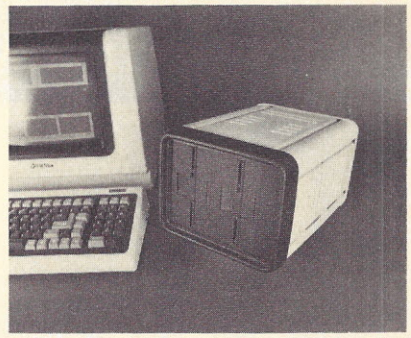
ZX-602 to take special advantage of the IO possible with Zendex's ZX-85 CPU card. The two connectors are meant to be wired to the ZX-903 reset and interrupt panel and the ZX-904 parallel IO unit. Price: $550. Zendex Corp., 6680 Sierra Lane, Dublin, CA 94566, (415) 829-1284.
CIRCLE INQUIRY NO. 225

PROM burner, Apparate PROM blasting system, is unique in that it will program nine different EPROMs on the same board. The system will program model 2704, 2708, 2716, 2732, 2508, 2516 and 2532



EPROMs. The package includes interface card, a complete set of personality modules, software on disk and a detailed instruction manual. Price: $149. Apparat Inc., 4401 S. Tamarac Parkway, Denver, CO 80237, (303) 741-1778.
CIRCLE INQUIRY NO. 226

Compact microcomputer, Episode, containing 64K RAM, dual serial I/O, parallel (Centronics) interface, floppy disk controller and battery powered calendar clock occupies a single 6-in. by 8-in. card. The computer offers a choice of storage capacities up to 1.6M bytes on dual 5¼-in. floppy disk drives. This fully contained computer occupies about the same desk space as a legal document and is designed to interface with a wide variety of peripherals. Versatility is assured through the computer's ability to interface with most CRT terminals and printers. Price: $2,550 including CP/M operating system and Supervyz. Epic Computer Corp.,



7542 Trade St., San Diego, CA 92121, (714) 569-0440.
CIRCLE INQUIRY NO. 227

Multipurpose work processor system is designed for small businesses, professionals and individual business applications in large corporations. DECmate provides users with a variety of office applications and data processing software, an enhanced version of Digital's word processing software list processing, alphabetic and numeric sort, and communications. The system is also programmable in several languages including Basic, Fortran and Dibol. The system's video display features include a 132-column presentation and high-speed chart graphics. In its base configuration, the system includes a dual-diskette unit, capable of storing up to 125 pages of text per document diskette, and an LA34 desktop matrix printer. It is also available with an


FMS-80
Organizes Your Organization
FMS-80, a data base management system, offers the user a quick and easy way to organize and efficiently manipulate data so sound decisions can be made on facts displayed.
FMS-80*** is the most powerful stand alone DBM program available to the microcomputer industry.
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• Mathematical manipulation of numeric data fields using the report generator or the programming language EFM (Extended File Maintenance)
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• FMS-80 is able to read data files that other programs have generated
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FMS-80 allows the flexibility to quickly create programs that allow data to be entered in a form that a secretary recognizes and generates reports that the manager requires.
If you're continuously asked to do applications programs and don't have time to do it in BASIC, consider FMS-80. For additional information contact
Systems Plus, 3975 East Bayshore, Palo Alto, CA 94303. Phone 415/969/7047
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LA120 2160-words-per-minute draft printer or LQPSE letter quality printer with optional sheet feeder. A roll-around minidesk and a

second dual-diskette drive, for a total of 375 pages of on-line storage, can be added. Digital Equipment Corp., Maynard, MA 01754, (603) 884-5101.
CIRCLE INQUIRY NO. 228

Desk-height 68000 computer system consists of a floppy disk, Winchester hard disk with tape cartridge backup, and the computer—all housed in a standard 19-in.

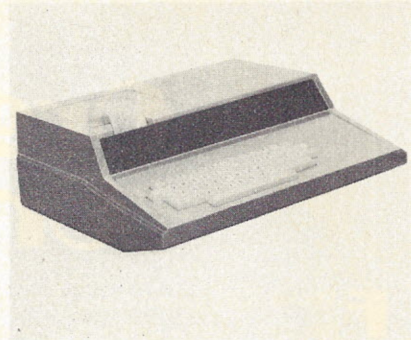
rack. The Winchester hard disk has a storage capacity of 20M bytes. An additional 20M bytes of storage is available as an option. The 8-in. IBM compatible floppy disk drive is provided with complete support software to enable media from IBM and CP/M to be converted. The floppy disk drive can also be used for field service test programs. The 8-MHz 68000 processor uses a 16-bit external data bus, but 32-bit internal values. The system has 16M bytes cf addressable memory. An 8-color 80 by 24 14-in. CRT display is standard. Q1 Corp., 125 Ricefield Lane, Hauppauge, NY 11781, (516) 543-7800.
CIRCLE INQUIRY NO. 229

Upgraded versions of the Microstar II small business system involve memory expansions for the standard 128K to 256K or 384K. Factory-installed 128K increments will be offered for $3,000 each. The basic Microstar II includes 128K, 2.4M bytes of diskette storage, plus software and will support up to four users. Options include 20M-byte hard disk, video display terminals and application software. Base configurations sell for $12,000 and are available under lease. Micro Five Corp., 17791 Sky Park Circle, Irvine, CA 92714, (714) 957-1517.
CIRCLE INQUIRY NO. 230

Word processing system, model 685, includes a processor with 64,000 bytes of memory, a keyboard, a half-page video display, a 5 million character fixed Winchester disk, an intelligent disk controller, a communications port and a built-in 655,000 character diskette for

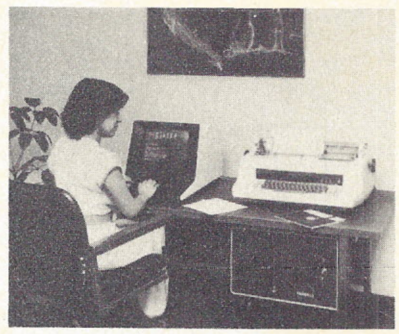
making copies of data. The machine offers plug-in, field expandable options, including additional memory of up to a total of 192,000 bytes, a full-page video display, additional communications ports and up to two more 5 million character disks. Price: $12,995. Compucorp, 1901 S. Bundy Dr., Los Angeles, CA 90025, (213) 820-2503.
CIRCLE INQUIRY NO. 231

Portable microcomputer system allows up to 10 modules to be added to a Rockwell Aim 65 microcomputer, within a



single enclosure. Using commercially available modules from many suppliers, the microcomputer system can drive floppies and minifloppies, cassettes, D to A and A to D modules, solid state relays, CRTs and printers. A disk operating system, software and application engineering are also offered. The AME 1000 includes the AME 400 enclosure, DMB 200 motherboard and DPS 512 power supply. Price: $625. Dynatem, 20881 Paseo Olma, El Toro, CA 92630, (714) 855-3235.
CIRCLE INQUIRY NO. 232

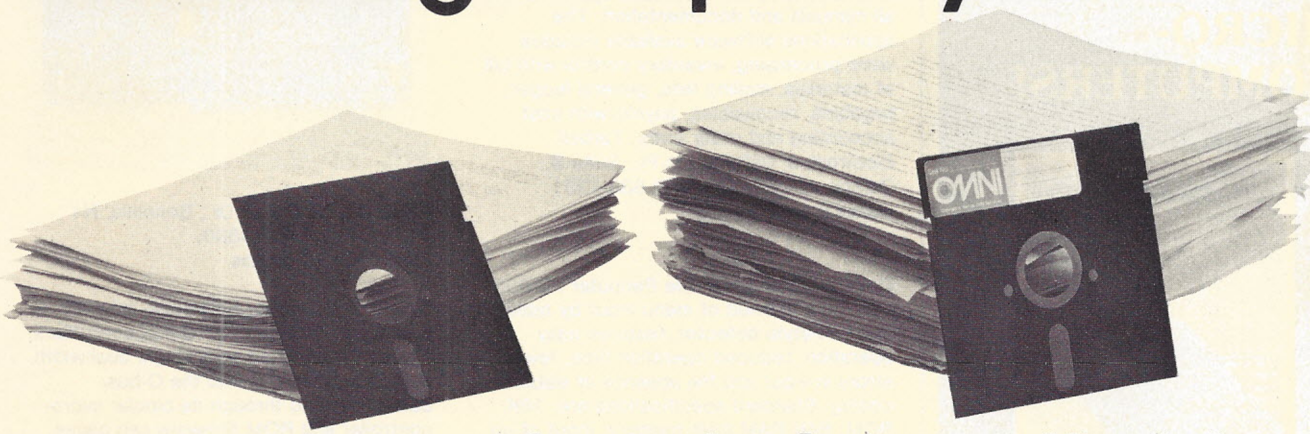
1 to 20M-byte system, the Empire, includes a Z80 4 Mhz CPU with memory management, timer and full interrupt



capability, two RS232 serial ports with handshaking, 64K bytes of RAM (expandable to 256K bytes), double

 CIRCLE INQUIRY NO. 62

Double your disk storage capacity...



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Shipping and handling $ 1.50
5% sales tax (Mass. only) $________
Total $________

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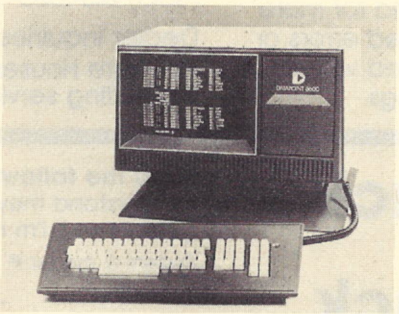
density floppy disk interface, two double density floppy disk drives, cabinet, power supply and cables. The timer, interrupts and memory management make it easier to build multi-user systems. The systems software includes: the Digital Research CP/M 2.2 disk operating system, Tarbell Disk Basic, Tarbell data base system and all manuals and documentation. The applications software available includes word processing, inventory control with bill of materials, mailing lists, general ledger, payables, receivables, payroll with cost accounting and order entry. Tarbell Electronics, 950 Dovlen Pl., Suite B, Carson, CA 90746, (213) 538-4251.

CIRCLE INQUIRY NO. 233

Computer system, the Penputer PS-850, utilizing a method of menu input by tablet and pen-style detector, features easy operation, reduced operation time, fewer errors in input and the absence of elaborate coding. Standard specifications are: 16K ROM, 64K RAM main memory; input of up to 81,000 items; a 14-in. CRT display with 80 characters by 24 lines, total characters (alphanumeric and symbols)—1,920. An 8-in. floppy disk with two drives also features double-sided, dual density—1M-byte by 2. A dot-impact printer accommodating 120 characters/second and 80 characters/line is compatible with the system. Acceptable software is Basic-80, CIS-Cobol and Fortran-80. Pentel of America, 2715 Columbia St., Torrance, CA 90503, (213) 775-1256.

CIRCLE INQUIRY NO. 234

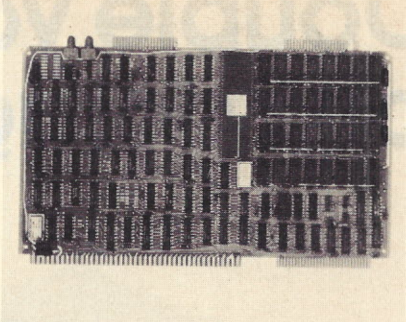
Processor and workstation, the 8600, features a large amber screen, a powerful central processor and a basic memory of 128K bytes of data plus parity that is expandable to 256K bytes. The memory consists of 16K-bit MOS dynamic memory chips and includes parity for improved reliability. Disk data transfers take place over high-speed direct memory access paths using gate array technology.



Datapoint Corp., 9725 Datapoint Dr., San Antonio, TX 78284.

CIRCLE INQUIRY NO. 235

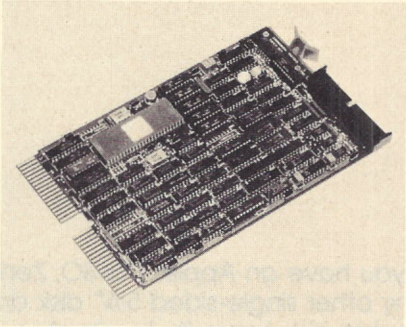
CPU board provides a full speed MC68000 as the CPU for a Multibus based system. 256K bytes of on-board RAM permit the MC68000 to execute code at full speed. The board is compatible with the proposed IEEE P796 at a compliance level of D16M20I16VO2L. Edge connectors for a logic analyzer are provided to ease debugging. Bus timeout protection, simple memory protection and interrupt type selection are also provided. TSD Display



Products, 35 Orville Dr., Bohemia, NY 11716, (516) 589-6800.

CIRCLE INQUIRY NO. 236

Operating system software, WDC11, is a family of multifunction Q-bus controllers. The unit, contained on a single dual-width card, plugs directly into the Q-bus backplane, and through its bipolar micro-controller and ROM firmware can cause popular independent and floppy disks to



emulate a variety of DEC devices. It serves three functions at once: with Winchester disks, it emulates DEC's RKO5 or RL01/2 hard disks, and with floppy disks it emulates DEC's RX02 floppy. It provides an on-board ROM book for system initialization. The unit has an inherent ability to handle Winchester backup to a floppy, all in a single controller, thus neatly eliminating one of the two controllers usually required. Price: $2,000. Andromeda Systems, 9000 Eton Ave., Canoga Park, CA 91304, (213) 709-7600.

CIRCLE INQUIRY NO. 237

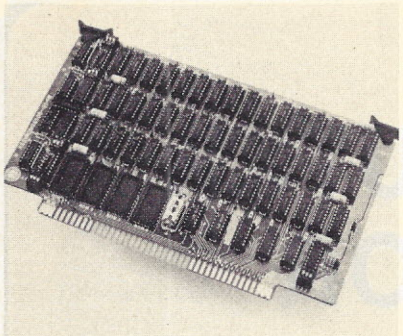
CPU card gives H-8 computer owners a choice of two CPUs. The Z80 CPU card is designed to replace the 8080A CPU. It includes a Z80 CPU. The HA-8-6 CPU card is compatible with all current Heath disk-based software for the H-8 computer. This new CPU card also includes all features of the HA-8-8 extended configuration option —eliminating the need to purchase the extended configuration option separately before adding the Heath CP/M operating system or the Heath H-47 8-in. floppy disk system. Price: $199. Heath Company, Benton Harbor, MI 49022, (616) 982-3210.

CIRCLE INQUIRY NO. 238

High density static memory module with up to 24K bytes of static RAM and sockets for up to 16K bytes of EMPROM/ROM includes write protect, over voltage and reverse polarity protection, and is available for either 1 MHz or 2 MHz operation. The module, GMS6508, is fully compatible with Motorola's Exorciser II and Rockwell's

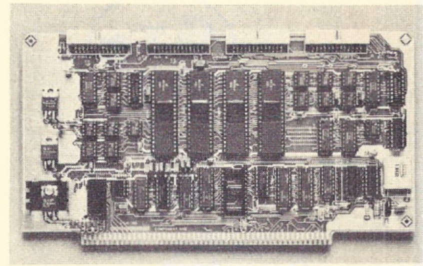
CIRCLE INQUIRY NO. 22

Aim 65 and System 65. Each module is also socketed to accept up to 16K (16,384 by



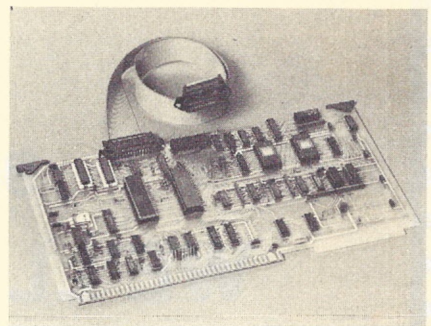
8) of EPROM/ROM (2532 type), organized in four 4K sections. Base memory address and enable/disable switches are provided for custom memory configurations. Price: $560. General Micro Systems, 1320 Chaffey Ct., Ontario, CA 91762, (714) 621-7532.
CIRCLE INQUIRY NO. 239

4-Port serial I/O interface, the CCS 2710, permits independent programmable port control, using four 8250 asynchronous communications elements. The programmer has extensive control over I/O format and operation. Each port has full handshaking to allow interfacing to a wide range of RS232C peripherals. The system interface meets IEEE proposed S-100 standards. Driver routines and/or other programs may be stored on-board in a user-supplied 2K EPROM. The base address of the ROM is jumper-selectable at any 2K boundary. If the phantom output is jumper-enabled, the ROM routines will overlay the system monitor or other memory sharing the



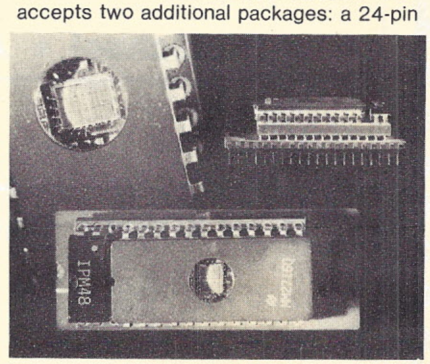
ROM's addresses. California Computer Systems, 250 Caribbean Dr., Sunnyvale, CA 94086, (408) 734-5811.
CIRCLE INQUIRY NO. 240

Bus controller card, HS-488, provides a simple means for multibus system communication among IEEE compatible instruments and peripherals at a transfer rate of 0-40,000 bytes/second. The package simplifies programming by providing an easy-to-use software driver sample with each bus. The driver subroutine (8080 assembly language) provides simple



commands including device addressing, sending and receiving data and directing other devices. ISIS or CP/M compatible disks are available options. Price: $895, including HS-488 bus, 3 ft. cable, and sample software driver. Information Development and Applications, Dept. 488, 10811 Tucker St., Beltsville, MD 20705, (301) 937-3600.
CIRCLE INQUIRY NO. 241

EPROM single chip microcomputer, the NS87P50, includes a plug-in adapter that accepts two additional packages: a 24-pin



EPROM (the 2758A, 2716 or 2732) which replaces the normally on-chip ROM of the INS8048 series, and a program module (IPM) that selects either the INS8048,

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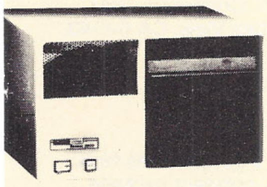
FEATURES



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- 20MB Winchester and Tape Backup
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- One Year Warranty on Entire System

2812 CP/M, 2 Single Sided Floppies	$3775.00
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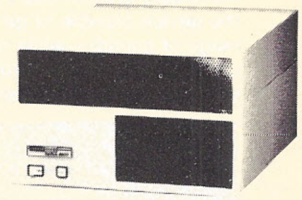
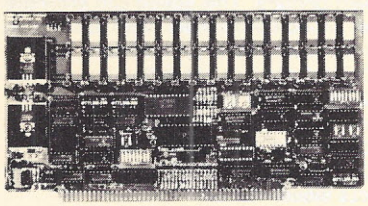
2829 MP/M, 1 10 MB Winchester & 1 Doubled Sided Floppy	7500.00



Model 2819/29

S-100 PRODUCTS



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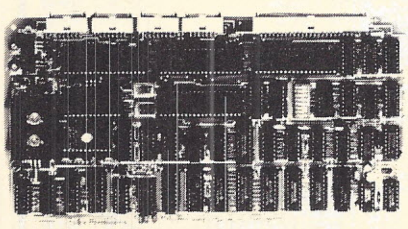
DM6400 64K	540.00
DM4800 48K	510.00
DM3200 32K	475.00



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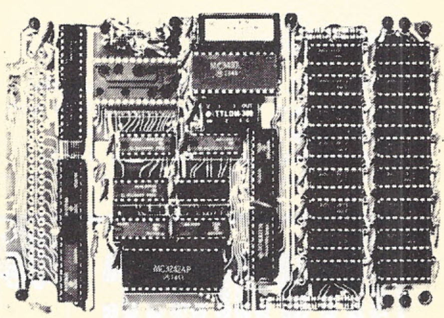

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AIM 65 KIM SYM PET S44-BUS

- Plug compatible with the AIM-65/SYM expansion connector by using a right angle connector (supplied).
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Assembled with 32K RAM	$349.00
& Tested with 16K RAM	329.00
Bare board, manual & 6 hard-to-get parts.	99.00
PET interface kit. Connects the 32K RAM board to a 4K or 8K PET	$ 69.00

AIM Professional Enclosure...$175.00

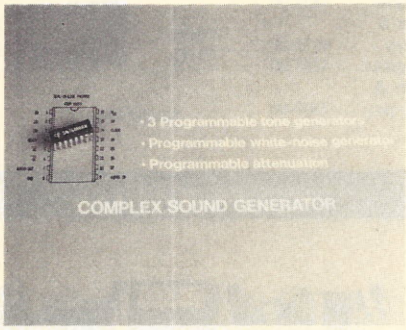
BETA COMPUTER DEVICES

1230 W. COLLINS AVE.
ORANGE, CA 92668
(714) 633-7280

master charge VISA

8049 or 8050 mode of operations. The piggyback microcomputer contains the system timing, control logic RAM data memory, EPROM and program module, plus 27 I/O lines to implement prototype program development emulation. National Semiconductor, 2900 Semiconductor Dr., Santa Clara, CA 95051, (408) 737-5000.
CIRCLE INQUIRY NO. 242

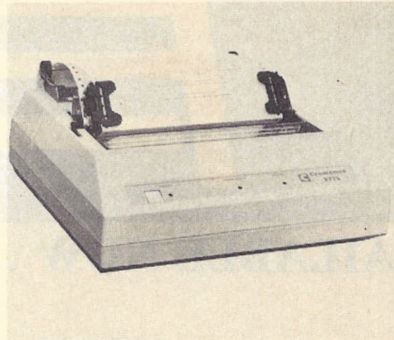
Sound-generator chip, SN76489AN, offers three independently programmable tone generators plus a multi-pitched noise source. The tone generators and noise source of the SN76489AN each have an individually programmable attenuator, making the device capable of generating a wide range of sounds—while requiring fewer components and less processor time than conventional sound-generation methods.



Offering TTL compatibility and a parallel 8-bit interface, the chip is compatible with most popular microprocessors. Price: $4.26 each in 1,000 quantities. Texas Instruments, Central Literature Response Center (SC-305), P.O. Box 202129, Dallas, TX 75220.
CIRCLE INQUIRY NO. 243

Video workstation, the 8220, is a full-function terminal and features ergonomic housing, a detached keyboard, an amber screen and optional tilt-swivel base. With a screen that measures 12 inches diagonally, the terminal displays 1,920 characters in 24 lines and 80 columns. The screen can be divided into windows, so that a menu can remain on one part of the screen while the rest is being used dynamically. The unit's character font includes all standard ASCII characters on a 7 by 9 dot matrix. Character fonts can also be downloaded from the host processor. Datapoint Corp., 9725 Datapoint Dr., San Antonio, TX 78284, (512) 699-6095.
CIRCLE INQUIRY NO. 244

Parallel printer for use with Cromemco systems prints 9 by 7 dot matrix characters at a rate of 150 characters per second. The 3715 model printer can print both upper-case and lower-case characters. It can also print character sets for both English and French. Using host generated control codes, character densities of either 10 characters per inch or 16.36 characters per inch are available. Both the 10 and 16.36 character densities can be elongated in a line by host generated codes. Elongated characters are printed double-width. The 3715 has a three-way paper handling system that accepts 9½-in. wide standard computer fanfold forms, 8½-in. wide roll paper and 8½-in. wide single



sheets. Price: $1,295. Cromemco, 280 Bernardo Ave., Mountain View, CA 94043, (415) 964-7400.
CIRCLE INQUIRY NO. 245

Printer/plotter, the V-80, provides high throughput in a quiet, compact package. One unit can provide the functions of three separate peripherals—a line printer, plotter and CRT hard copy device. The V-80 prints up to 1,000 lines per minute, over three times faster than competitively priced impact printers. This speed can eliminate peak period bottlenecks often associated with conventional impact printers. High—200 point per inch resolution means that 132-column line printer format fits on an 11-in. wide by 8½-in. page. Versatec, 2805 Bowers Ave., Santa Clara, CA 95051, (408) 988-2801.
CIRCLE INQUIRY NO. 246

CIRCLE INQUIRY NO. 105

CALENDAR

Jan 7-10 Consumer Electronics Show, Convention Center, Hilton Hotel and Jockey Club, Las Vegas, NV, over 800 exhibitors of electronics equipment, along with conferences, workshops and seminars. Consumer Electronics Shows, Two Illinois Center, Suite 1607, 233 N. Michigan, Chicago, IL 60601.

Jan 14 Invitational Computer Conference, S. Coast Plaza Hotel, Orange County, CA, seminar/display directed exclusively to the needs of the quantity buyer of computer and peripheral equipment. Also held: Feb. 10, Pier 66 Hotel, Ft. Lauderdale, FL; Mar 23, Marriott Hotel, Dallas, TX; Mar 25, Adam's Mark Hotel, Houston, TX; and Apr 14, Sheraton Hotel, Southfield, MI. B.J. Johnson and Assoc., 2503 Eastbluff Dr., Suite 203, Newport Beach, CA 92660.

Jan 15-16 Math/Science Conference, Arizona State U., Tempe, AZ, workshops, demonstrations, and seminars on the microcomputer as a medium for instruction, a tool for research and an information manager. Nancy Watson, 203 Payne Hall, Arizona State U., Tempe, AZ 85287.

Jan 18-22 World of Concrete '82, World Congress Center, Atlanta, GA, seminar dealing with hardware and software for contractors. World of Concrete, Dept. CN, 426 S. Westgate, Addison, IL 60101, (800) 232-3550.

Jan 21-23 Pacific Computer Exposition, Convention and Performing Arts Center, San Diego, CA, featuring software and hardware of interest to business, industry, education and homeowners. AMUS, 1911 11th St., Suite 210, Boulder, CO 80302, (303) 449-6917. Williams Professionals, 2333 Camino Del Rio South, Suite 150, San Diego, CA 92108, (714) 296-4025.

Jan 21-26 National Audio-Visual Convention and Exhibit, Disneyland Hotel, Anaheim, CA, displaying a wide range of audio-visual, video and microcomputer products for job training, marketing, industry, sales training, point-of-purchase selling, safety, public relations, education, government, military, health professions, churches and community agencies. National Audio-Visual Assoc., 3150 Spring St., Fairfax, VA 22031, (703) 273-7200.

Jan 24-29 Alpha Micro Users Society Convention, Deauville Hotel, Miami Beach, FL, demonstrations and workshops on communications, assembly language, structured programming. AMUS, 1911 11th St., Suite 210, Boulder, CO 80302, (303) 449-6917.

Jan 26-28 Advanced Semiconductor Equipment Exposition, Convention Center, San Jose, CA, featuring technical representatives of equipment suppliers focusing on key issues on semiconductor device manufacturing equipment and processes. Show Management, Cartlidge and Assoc., 491 Macara Ave., Sunnyvale, CA 94086, (408) 245-6870.

Jan 29-30 Modeling and Simulation on Microcomputers, Bahia Hotel, San Diego, CA, conference sponsored by the Society for Computer Simulation, featuring papers, panel discussions and tutorials. SCS, Box 2228, La Jolla, CA 92038.

Feb 8-11 ACM Computer Science Conference, Convention Center, Indianapolis, IN, aiding in matching computer scientists and data processing specialists with employment opportunities. Orrin E. Taulbee, ACM Computer Science Employment Register, Dept. of Computer Science, U. of Pittsburgh, Pittsburgh, PA 15260.

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SBC-200, 64K ExpandoRAM II, Versafloppy II, CP/M 2.2

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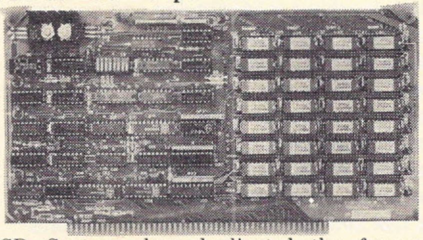
4 MHz Z-80A CPU, 64K RAM, serial I/O port, parallel I/O port, double-density disk controller, CP/M 2.2 disk and manuals, system monitor, control and diagnostic software.

-All boards are assembled and tested-

ExpandoRAM III

64K to 256K expandable RAM board



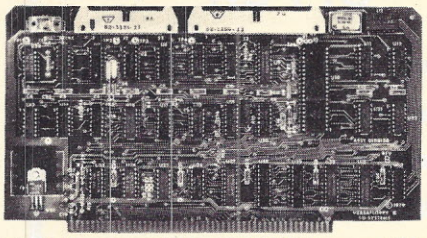
SD Systems has duplicated the famous reliability of their ExpandoRAM I and II boards in the new ExpandoRAM III, a board capable of containing 256K of high speed RAM. Utilizing the new 64K x 1 dymanic RAM chips, you can configure a memory of 64K, 128K, 192K, or 256K, all on one S-100 board. Memory address decoding is done by a programmed bipolar ROM so that the memory map may be dip-switch configured to work with either COSMOS/MPM-type systems or with OASIS-type systems.

Extensive application notes concerning how to operate the ExpandoRAM III with Cromemco, Intersystems, and other popular 4 MHz Z-80 systems are contained in the manual.

MEM-65064A *64K A & T* **$495.00**
MEM-65128A *128K A & T* **$639.95**
MEM-65192A *192K A & T* **$769.95**
MEM-65256A *256K A & T* **$879.95**

Versafloppy II

Double density controller with CP/M 2.2



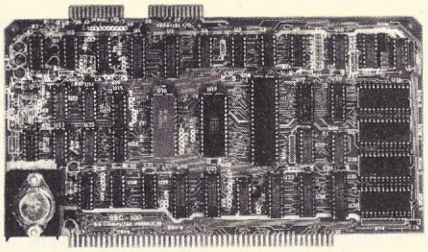
• S-100 bus compatible • IBM 3740 compatible soft sectored format • Controls single and double-sided drives, single or double density, 5¼" and 8" drives in any combination of four simultaneously • Drive select and side select circuitry • Analog phase-locked loop data seperator • Vectored interrupt operation optional • CP/M 2.2 disk and manual set included • Control/diagnostic software PROM included

The Versafloppy II is faster, more stable and more tolerant of bit shift and "jitter" than most controllers. CP/M 2.2 and all necessary control and diagnostic software are included.

IOD-1160A *A & T with CP/M 2.2* .. **$370.00**

SBC-200

2 or 4 MHz single board computer



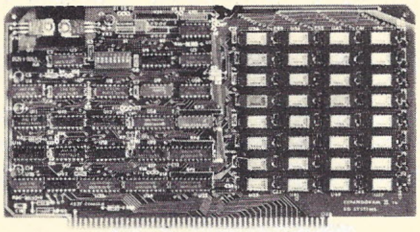
• S-100 bus compatible • Powerful 4MHz Z-80A CPU • Synchronous/asynchronous serial I/O port with RS-232 interface and software programmable baud rates up to 9600 baud • Parallel input and parallel output port • Four channel counter/timer • Four maskable, vectored interrupt inputs and a non-maskable interrupt • 1K of on-board RAM • Up to 32K of on-board ROM • System monitor PROM included

The SBC-200 is an excellent CPU board to base a microcomputer system around. With on-board RAM, ROM, and I/O, the SBC-200 allows you to build a powerful three-board system that has the same features found in most five-board microcomputers. The SBC-200 is compatible with both single-user and multi-user systems.

CPU-30200A *A & T with monitor* . **$299.95**

ExpandoRAM II

16K to 64K expandable RAM board



• S-100 bus compatible • Up to 4MHz operation • Expandable from 16K to 64K • Uses 16 x 1 4116 memory chips • Page mode operation allows up to 8 memory boards on the bus • Phantom output disable • Invisible on-board refresh

The ExpandoRAM II is compatible with most S-100 CPUs. When other SD System' series II boards are combined with the ExpandoRAM II, they create a microcomputer system with exceptional capabilities and features.

MEM-16630A *16K A & T* **$325.00**
MEM-32631A *32K A & T* **$345.00**
MEM-48632A *48K A & T* **$365.00**
MEM-64633A *64K A & T* **$385.00**

COSMOS

Multi-user operating system

• Multi-user disk operating system • Allows up to 8 users to run independent jobs concurrently • Each user has a seperate file directory

COMOS supports all the file structures of CP/M 2.2, and is compatible at the applications program level with CP/M 2.2, so that most programs written to run under CP/M 2.2 or SDOS will also run under COSMOS.

SFC-55009039F *COSMOS on 8" disk* **$395.00**

Multi-User System

SBC-200, 256K ExpandoRAM III, Versafloppy II, MPC-4 COSMOS Multi-User Operating System, C BASIC II

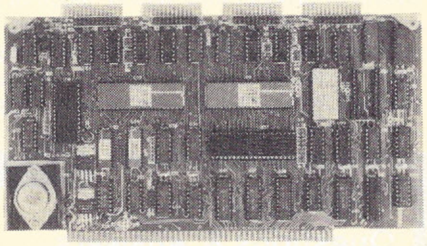
$1995.00

Two Z-80A CPUs (4 MHz), 256K RAM, 5 serial I/O ports with independently programmable baud rates and vectored interrupts, parallel input port, parallel output port, 8 counter/timer channels, real time clock, single and double sided/single or double density disk controller for 5¼" and 8" drives, up to 36K of on-board ROM, CP/M 2.2 compatible COSMOS interrupt driven multi-user disk operating system, allows up to 8 users to run independent jobs concurrently, C BASIC II, control and diagnostic software in PROM included.

-All boards are assembled and tested-

MPC-4

Intelligent communications interface



• Four buffered serial I/O ports • On-board Z-80A processor • Four CTC channels • Independently programmable baud rates • Vectored interrupt capability • Up to 4K of on-board PROM • Up to 2K of on-board RAM • On-board firmware

This is not just another four-port serial I/O board! The on-board processor and firmware provide sufficient intelligence to allow the MPC-4 to handle time consuming I/O tasks, rather than loading down your CPU. To increase overall efficiency, each serial channel has an 80 character input buffer and a 128 character output buffer. The on-board firmware can be modified to make the board SDLC or BISYNC compatible. In combination with SD's COSMOS operating system (which is included with the MPC-4), this board makes a perfect building block for a multi-user system.

IOI-1504A *A & T with COSMOS* .. **$495.00**

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BOOK REVIEWS

Video/Computers: How to Select, Mix and Operate Personal Computers and Home Video Systems
by Charles J. Sippl and Fred Dahl
Prentice Hall, Englewood Cliffs, NJ

Reviewed by Rocky Smolin

Even from a strictly sociological viewpoint, this book is fascinating for what it foretells of the next major revolution in our lifestyles—the advent of the appliance computer at home. When this device becomes as common as a blender or a clock radio, integrated with our TV, our VCR and our telephone, it will enable not just reception of information, but interaction with the outside world as well. Eventually, off-the-shelf products will make what the authors call the integrated video terminal (IVT) as simple to buy and use as a microwave oven.

Even though all the pieces are now present, for the next few years implementing your own IVT at home will entail a large do-it-yourself component. This book provides an excellent and comprehensive treatment of the subject. The approach is to try to outline the basic components of this video revolution and anticipate which developments are likely to become the standards of an integrated system.

The book is uniquely organized around various viewpoints —the video enthusiast, the computerist, the communicator and the public. It is fairly technical in nature and presents a wealth of product information, much of which will be quickly outdated. The appearance of IVTs in the marketplace will obsolete much of the rest of the book by doing away with the need to know how to buy and integrate the components yourself. Nevertheless, the book is a fascinating glimpse into the future, as well as a practical guide to those who want to participate in this revolution today.

245 pages $7.95

Computer Security Management
by Donn B. Parker
Reston Publishing, Reston, VA

There are no new crimes—only new tools with which to commit the same old ones. The advent of computer systems to handle great quantities of information and to manage millions of financial transactions has only resulted in automated crime. This comprehensive book covers the current state-of-the-art in computer security.

Since most previous writings on this topic dealt primarily with safeguards against human errors and omissions, most of this material was ineffective against the intelligent enemy of the computer system. This book, therefore, is heavily weighted towards the human factors involved in identifying and neutralizing threats against computer systems.

The first section deals realistically with how the MIS system has become a real power base in the corporation, how this power creates its own need for security, and what the security needs are among the various users of the computer system.

The second part is a very enlightening discussion of the nature of computer security, wherein the author defines security topics, such as risk avoidance, the nature of threats, and the characteristics of accidental and intentional acts.

The final section guides the reader in the establishment of a computer security program. Parker's experienced and

erudite approach provides readers with all the tools they may require in establishing a security program for their company. This is not light reading. Parker's style is somewhat dry and functional. However, the book is highly recommended as a reference source. **—RS**

308 pages $23.95

Experiments in Artificial Intelligence For Small Computers
by John Krutch
Howard W. Sams, Indianapolis, IN

Reviewed by David D. Busch

Probably a better title for this book would be "Experiments in Simulating Intelligence For Small Computers." For, as the author points out in several places, none of the programs discussed actually "understand" anything. True artificial intelligence in the small computer still appears to be a long way off.

However, if you are interested in the inner workings of the well-known Eliza and Doctor programs, or just want to have a greater understanding of how computers must be programmed to solve problems, you will want to read this book. Krutch proceeds from simple game-playing programs to more advanced modules that can solve syllogisms, write Haiku, or compose endless pages of grammatical—but essentially meaningless—sentences. The "intelligence" displayed is questionable, but the simulations have fooled us all at one time or another.

This groundwork is accompanied by programs that can be typed in by the reader, and run on a TRS-80 model I or III, or other microcomputer using a similar language. Krutch provides a glossary that may be useful in translating to other dialects, but some of his programs use special features (such as PRINT @) needlessly. Even owners of computers with very similar Basics, such as the Apple II, will have some work ahead of them.

A complete discussion of programs that simulate natural language conversations winds up the book. Readers are provided with their own version of Eliza, which most should be able to modify and customize to their needs.

110 pages $6.95

How to Get Started with CP/M
by Carl Townsend
Dilithium Press, Beaverton, OR

Reviewed by Alfred A. Adler, Ph.D.

CP/M is probably the most widely known and widely used operating system for microcomputers. A vast array of utilities and applications software is available to run under it. Unfortunately, the rank beginner who attempts to implement it will have considerable difficulty in understanding the documentation. An introductory treatment is certainly helpful.

This book is the first of two volumes. It is a beginner's manual, giving a good overview of the operating system, an idea of what it will be like to use it, and what it can do for you. The book is rather short and can be easily read by someone totally unfamiliar with computers.

It gives an accurate overview and serves very nicely to present the naive beginner with a transition to the CP/M documentation, although it is not clear whether the transition is sufficient. It also gives the more experienced computerist a foretaste of CP/M as an aid in determining whether he would like to acquire and use the system. In these respects, the book serves its purpose, but probably has little reference value.

127 pages $9.95

Free Literature

Microcomputer workshops are detailed in brochure. A wide selection of lab-intensive workshops on Intel's microcomputer components, boards, software, operating systems, and design tools are listed. These are available at the beginner, intermediate and advanced levels. They are conducted at training centers in the Boston, Chicago, Dallas and San Francisco Bay areas. Selected workshops are also offered periodically in other metropolitan areas. Intel Corp., Customer Training, 27 Industrial Ave., Chelmsford, MA 01824-3688.

CIRCLE INQUIRY NO. 201

Personal computer disk systems are featured in catalog. Also listed are add-on drives, LSI-11 compatible disk systems, backup systems products, network multiplexers, and interface cards, cables, demo kits, software, accessories and manuals. Corvus Systems, 2029 O'Toole Ave., San Jose, CA 95131.

CIRCLE INQUIRY NO. 202

Insurance problems faced by the electronics industry are detailed in booklet. According to the booklet, there are many coverages that are vital to the insurance needs of electronic firms. These include product liability, errors and omissions, damage to product coverage, loss of project protection, income protection, property valuation protection and broad "all risk" coverage. The booklet presents case histories of these specialized coverages as well as unusual ways to respond to some of the more usual coverages. Chubb Electronics Booklet, 1700 Broadway, 5th Floor, New York, NY 10019.

CIRCLE INQUIRY NO. 203

Pushbutton switches and indicators are detailed in 52-page catalog, intended as a ready source of information to familiarize designers, engineers and buyers with the design, construction, operational characteristics and specifications for the Optolite product line. Detailed are Presslite switches, indicators, friction caps, pushbuttons, mounting hardware, low-profiles, rainbows, watertight, splashproof, EMI-suppressed, splitlegend and Macroflex switches and incandescent, neon and LED indicators. Oak Switch Systems, Box 517, Crystal Lake, IL 60014.

CIRCLE INQUIRY NO. 204

Book catalog features ten books containing dozens of tips, tricks, secrets and shortcuts for programming newcomers as well as hundreds of fresh programs. All programs have been thoroughly tested and are ready to run. Arcsoft Publishers, Box 132-IA, Woodsboro, MD 21798.

CIRCLE INQUIRY NO. 205

Conversion package checklist is included in a brochure for comparing IBM System/34 to System/38 conversion packages. This list can also be used as a planning tool to help determine the tasks necessary to complete the conversion. Richard Hart, Application Development Services, 1700 E. Dyer Rd. #214, Santa Ana, CA 92705.

CIRCLE INQUIRY NO. 206

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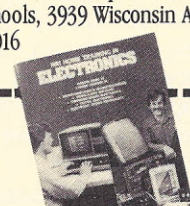

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The Portable Computer is Here
Continued from page 72

metic logic unit and status registers. It also provides communication between the data/address buffers and instruction register.

There are 22 registers accessible to the programmer, divided into three main groups. Moreover, the NSC800 instruction set is completely Z80 software-compatible. All of the Z80 instruction set features also apply here, including the block, I/O and memory transfers and bit sets, resets, and tests, as well as indexed addressing.

The CPU uses a multiplexed bus structure, identical to that used in the 8085, to economize on pin functions and simplify PC board layout. A power-save function has been incorporated for systems requiring maximum power savings. When this feature is activated, the CPU will stop all internal clocks at the end of the current instruction, yet maintain all internal status and data register values. Only the oscillator and system CLK output are still operating during power save. Thus power dissipation in the CPU can be halved during power save.

Supporting the NSC800 CPU are the NSC810 RAM-I/O Timer and the NSC830 ROM I/O, dedicated devices that include on-chip logic for direct interface to the NSC800 multiplexed system bus. Fabricated using P²CMOS, both devices provide high performance with low power consumption.

The NSC810 is a 40-pin device containing 1,024 bits of static RAM organized as 128 by 8 bits. The I/O portion consists of 22 programmable input/output bits arranged as three separate ports, with each bit individually definable as an input or an output. The timer portion of the device, which operates over a range from DC to 4MHZ, consists of two programmable 16-bit binary down counters, each capable of operation in one of six modes. The unit contains 16,384 bits of ROM organized as 2,048 by 8 bits. The I/O portion consists of 20 programmable input/output bits arranged in a manner similar to the NSC810. Also available is the NSC831, an NSC830 without ROM. It is useful for prototyping work before using the NSC830, or when on-chip ROM is not required.

To support the NSC800 family, National has a full line of traditional CMOS components including memories, analog interfaces, a full logic family and general or dedicated function peripheral devices. In addition, a complete line of high performance, low power double poly memory and interface components is under development.

After almost a decade of research and development, a wide variety of flat panel display technologies is emerging from the laboratories in the U.S. and Japan, and will soon begin appearing in consumer products. These include: light emitting diodes, liquid crystral displays, electroluminescent, gas discharge, electrophoretics, electrochromics and magnetic particle displays. From Japan come a variety of flat panel alphanumeric displays.

The ISE Electronics display shows the full ASCII character font in bright green figures, while keeping voltage low and power consumption down. Both thin and thick film fabrication technologies have been used for the anode substrate. The 240 characters are divided into six lines of 40 characters, each being formed from a 5 by 7 dot matrix. Forty grids allow timesharing control of cathode emission. Each grid covers a full column containing six characters. The 40 grids enable the display to operate with about a $\frac{1}{40}$th duty cycle, which reduces the voltage required to produce a high level of brightness. With 5mm high by 3mm wide characters, the display measures 250 by 100mm overall and is 14.5mm thick.

The 80 character LCD subsystem from Hitachi is also based on 5 by 7 dot matrices and uses 11 CMOS circuits for drivers. Ten of the ICs drive the 400 information lines for 80 characters, while the eleventh drives the seven address lines. Each CMOS IC driver consists of a 40 stage shift register, data latch and other logic circuits.

The storage LCD from NEC uses a new LCD based on dielectrically positive cholesteric liquid crystal material and offers several advantages: long storage times, making refreshing unnecessary; more than 100 scanning lines; low driving voltages, compatible with NMOS and CMOS LSI and VLSI circuits; very wide viewing angles; and excellent appearance.

A wide variety of flat panel technologies is emerging . . .

The vertical self shift plasma display panel (PDP) from Fujitsu offers convenient editing and tabulation capabilities. Yet it also retains the simple driving circuitry of a self shift PDP. In the horizontal PDP, the characters appear at the right edge of the panel and move left as typing continues. Thus advance knowledge of the character's final position for alignment is impossible. One way to overcome this in the old self shift PDP is to refresh the entire line immediately after each character is typed in. But the time required for the refresh is too long to be practical. For example, about 200 mS is required in the case of 65 characters per line.

The vertical self-shift PDP has two other significant advantages. First, the number of lines can be expanded without increasing the driving circuitry complexity, as is the case in the horizontal self-shift PDP. And the display contents can be easily scrolled up or down, very difficult with the horizontal self-shift PDP.

Sharp Corporation has developed a flat panel TV display using a memory-type thin film electroluminescent panel with 220 by 160 dot elements. The display can freeze the picture at any instant without any external frame memory.

At NHK (Japan Broadcasting Corp.), work is underway on a flat panel color TV display system incorporating planar positive column cells, in which a gas discharge positive column is formed parallel to the panel surface. The cells are used in a 10-in. diagonal color TV display containing 95 by 384 cells. Although each column in the panel has no more than 95 pixels, the number of rows can be counted as 190 because of a zigzag pixel arrangement.

In the U.S., Westinghouse has been developing a 6 by 6-in. display using a liquid crystal matrix addressed by a thin film transistor. Resolution of the panel is 30 lines per inch, as contrasted with an earlier version of

only 20 lines per inch. The panel is addressed one line at a time, and the amplitude information is stored simultaneously in a row of peripheral capacitors that are discharged together into columns by the transistors of the line in the matrix circuit. These are turned on by a positive pulse supplied by a vertical scanner. The stored charges are divided between the peripheral capacitors in the display elements.

Hughes Aircraft has developed a 30,625 element LCD video display using MOS addressing circuitry. The display has 100 lines per inch in a 1.75-sq.-in. display with a 2.5-in. diagonal.

RCA has designed a flat panel display capable of being fabricated in sizes up to 30 by 40 inches, consisting of a matrix of ion feedback multiplier vanes and about 500 horizontal cathode addressing electrodes. A line is addressed by switching a single cathode electrode to an appropriate voltage, so that ion feedback discharges can occur only along the vertical multipliers that cross by that cathode. Additional electrons on the vertical multipliers make certain that only a single element within each of 40 modules is on at any one instant. With the proper combination of select electrodes, the display can be multiplexed so that only 40 modulation circuits are required.

From Kylex Corp., Mountain View, CA, comes a flat panel LCD approach called Thermally Addressed Dye Display (TADD). The company claims that it surpasses conventional LCD technology in image contrast, view cone and brightness. Further, TADD retains the image when the electrical field is removed.

TADD introduces a guest dye molecule that is attached to the host liquid crystals. The dye mirrors the physical structure of the liquid crystal while following the orientation of the LC molecules. As a result, the dye is not visible unless in a particular orientation to the viewer. The ability to address and alter an individual pixel by the combination of electrical and thermal effects makes TADD revolutionary in large area flat panel displays.

In displays based on the TADD approach, each pixel is addressed by a combination of a row signal and a column signal. The multiplexing electronics required to generate the signals are row drivers, column drivers and a control module. The row drivers provide the current pulses for heating the rows of the TADD panel and converting the liquid crystal material into the isotropic state where the molecules are randomized.

Pixels to increase

The column drivers provide the voltage signal that is applied to each pixel during the initial stage of its cooldown cycle. These drivers are characterized by medium voltage, low current and static discharge tolerance.

Currently, Kylex is fabricating displays in an array of pixel configurations with 288 rows and 357 columns (102,816 pixels), utilizing glass substrates measuring 6 by 7 inches. By next year, Kylex expects to be supplying displays with more than 160,000 pixels and soon thereafter displays with more than 400,000 pixels and as large as 8½ by 11 inches, using TADD technology. At Lucitron, in Northbrook, IL, a 35-in. diagonal panel is under development using DC-plasma technology.

Other companies actively involved in flat panel display development include Rockwell (AC thin film electroluminescent); Sigmatron-Nova (electroluminescent); the French firm LETI (LCD); Phosphor Products Co., Dorset, England (dot matrix DC electroluminescent); and Hycom Inc. (electroluminescent).

The CRT, however, is still a formidable target for all these challengers, with several projects underway to produce flat panel CRTs. Texas Instruments, for example, had developed a flat CRT capable of presenting full color video, as well as high information content alphanumeric data. Instead of a single analog deflected beam as used in conventional CRTs, this flat CRT uses multiple electron beams generated from an area cathode, then formed and digitally addressed by a switching stack. The flat tube display has been used to construct a color video tube that displays 76,800 pixels.

Employing a "fold" technique

And Sinclair has developed a flat CRT by "folding" a conventional CRT. The electron source is set to one side of the screen. The axis of the electron optics is parallel to the screen rather than perpendicular to it. Two sets of electrostatic deflection plates in the source assembly provide horizontal and vertical scanning, while a third set of plates between the phosphor screen and front face bends the electron beam toward the screen.

The screen for Sinclair's flat CRT is assembled from just two sheets of glass: a flat front plate and a vacuum-formed back plate. The phosphor screen is coated on the inside of the backing plate, and is viewed through the front plate, from the same side the electrons strike. As a result, the brightness is more than double that of a conventional CRT with the same beam energy. By comparison, the conventional CRT displays the image through a binder that fixes the phosphor to the screen. The binder, however, reduces brightness.

Several of the Japanese firms have already introduced prototypes of small handheld portable TVs using LCD technology. At the other end of the spectrum, Lucitron and RCA are planning very large flat panel TV displays that can be hung on the wall.

In the personal computer market, a few firms are moving in the direction of more portability. Kylex, using its TADD technology, has introduced the KT-111, a lightweight portable computer terminal using an 8-in. flat panel display and only ¾ths of an inch thick. Built around the Z80 microcomputer, the KT-111 has a full typewriter keyboard, built in modem with an acoustic modem coupler, and weighs only 15 pounds.

Using standard display technology, Otrona Corp. of Boulder, CO, has introduced the Attache, a Z80-based system weighing less than 20 pounds and only half a cubic foot in size. It incorporates a 5-in. display, a full size flip-down keyboard, and 64K bytes of RAM.

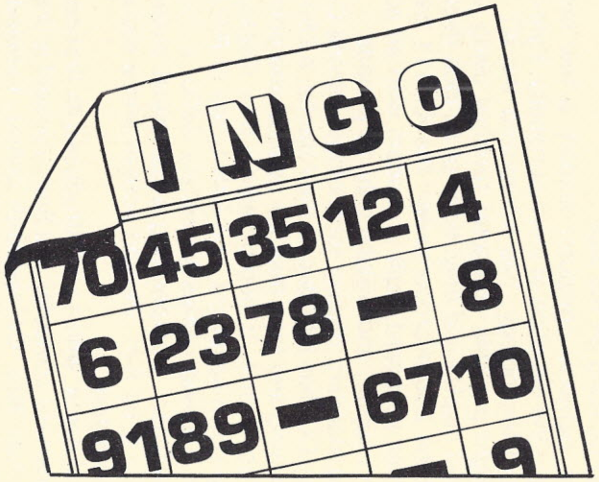
From England comes Microdata 8400, a computer in a briefcase, incorporating a flat panel plasma display with 8 by 8-in. viewing screen and a capacity of 480 characters.

And at Xerox, which just introduced its first personal/small business computer, the Star, a project is underway at the Palo Alto, CA research center. Labeled Dynabook, the goal is to couple a flat panel display screen with a computer as powerful as the Star, but in a box that measures 2 by 9 by 11 inches.

Finally, look for Sinclair to combine its new flat panel CRT with its ZX80 handheld computer within the next year. □

Inquiry Handling with a Microcomputer

Continued from page 97



BINGO – SALES INQUIRY HANDLING SERVICE — SEP. 23, 1981
MONTHLY STATUS – TOTAL LEADS PER PUBLICATION — FROM: 05/01/81 – 05/31/81
FOR : WESTERN WIDGET WORLD, INC. — PAGE : 1

PUBLICATION/SOURCE	ISSUE DATE	ITEM OF INTEREST	# LEADS 05/81	# LEADS TOTAL
WIDGET WEEKLY	04/01/81	AD – NEW TURBO-WIDGE	6	6
		AD – 1-CENT SALE	7	7
*** TOTAL			13	13
MODERN WIDGETS	05/01/81	AD – S-100 WIDGET	2	2
		AD – NEW TURBO-WIDGE	6	6
*** TOTAL			6	6
WIDGET WORLD	05/01/81	AD – 1-CENT SALE	3	15
		PR – NEW MFG. FACILI	0	6
		PR – GASAHOL FROM WI	5	5
*** TOTAL			5	5
WIDGET WORLD	04/01/81	AD – 1-CENT SALE	3	15
		PR – NEW MFG. FACILI	0	6
		PR – GASAHOL FROM WI	5	5
*** TOTAL			3	21
MODERN WIDGETS	03/01/81	AD – S-100 WIDGET	2	2
		AD – NEW TURBO-WIDGE	6	6
*** TOTAL			2	2
*** TOTALS			29	47

Figure 4. Responses by publication

BINGO – SALES INQUIRY HANDLING SERVICE — SEP. 23, 1981
MONTHLY STATUS – TOTAL LEADS PER ITEM — FROM: 05/01/81 – 05/31/81
FOR : WESTERN WIDGET WORLD, INC. — PAGE : 1

ITEM OF INTEREST	PUBLICATION/SHOW	ISSUE/DATE	# LEADS 05/81	# LEADS TOTAL
AD – NEW TURBO-WIDGET	WIDGET WEEKLY	04/01/81	6	6
	MODERN WIDGETS	05/01/81	6	6
*** TOTAL			12	12
AD – 1-CENT SALE	WIDGET WORLD	04/01/81	3	15
	WIDGET WEEKLY	04/01/81	7	7
*** TOTAL			10	22
PR – GASAHOL FROM WIDGET	WIDGET WORLD	05/01/81	5	5
*** TOTAL			5	5
AD – S-100 WIDGET	MODERN WIDGETS	03/01/81	2	2
*** TOTAL			2	2
PR – NEW MFG. FACILITY	WIDGET WORLD	04/01/81	0	6
*** TOTAL			0	6
TOTALS			29	47

Figure 5. Responses by item

BINGO - SALES INQUIRY HANDLING SERVICE   SEP. 23, 19
MONTHLY TOTALS   FROM: 04/01/81 - 06/30/
FOR : WESTERN WIDGET WORLD, INC.   PAGE :

PUBLICATION/SOURCE		APR	MAY	JUN	3 MOS.	TO DATE
WIDGET WORLD		18	8	1	27	27
MODERN WIDGETS		0	8	0	8	8
WIDGET WEEKLY		0	13	3	16	16
TOTALS:	3	18	29	4	51	51

ITEM OF INTEREST		APR	MAY	JUN	3 MOS.	TO DATE
AD - S-100 WIDGET		0	2	0	2	2
AD - NEW TURBO-WIDGET		0	12	0	12	12
PR - NEW MFG. FACILITY		6	0	0	6	6
PR - GASAHOL FROM WIDGETS		0	5	1	6	6
AD - 1-CENT SALE		12	10	3	25	25
TOTALS:	5	18	29	4	51	51

AREA		APR	MAY	JUN	3 MOS.	TO DATE
CANADA		0	2	1	3	3
EAST		10	15	1	26	26
CENTRAL		6	9	1	16	16
SOUTH		0	1	1	2	2
SOUTHWEST		2	1	0	3	3
NORTHWEST		0	1	0	1	1
TOTALS:	6	18	29	4	51	51

Figure 6. Comprehensive report

The Pocket Computer as a Travel Guide

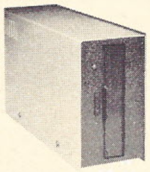
Continued from page 115

Program listing

```
10  : REM              INITIALIZE
20  : REM
30  :INPUT "ENTER TANK CAPACITY";V
40  :J=V
50  :INPUT "ENTER EST. MPG";L
60  :INPUT "ENTER MILES TO DESTINATION :";D
70  :INPUT "ENTER HOUR (24 HR. FORMAT) ";H
80  :INPUT "ENTER MINUTES";M
90  :INPUT "ENTER STARTING ODO READING";B
100 : Q=B
110 : REM              MENU
120 : REM
130 : "A" :  INPUT "(E)TA (M)PG (A)VG MPH (G)AL.";A$
140 :INPUT "(U)PDATE OR (S)AME DATA";C$
150 :IF C$="U" THEN F=1 ELSE F=0
160 :IF A$="E" GOTO 230
170 :IF A$="M" GOTO 500
180 :IF A$="A" GOTO 300
190 :IF A$="G" GOTO 620
200 :GOTO 130
210 : REM              CALCULATE ETA
220 : REM
230 :IF F=1 GOSUB 360
240 :IF U<1 GOTO 130
250 :PRINT "MILES TRAVELED :";U
260 :PRINT "AT THIS SPEED YOU WILL ARRIVE AT";P
270 :GOTO 130
280 : REM              CALCULATE  MPH
290 : REM
300 :IF F=1 THEN GOSUB 360
310 :PRINT "MILES TRAVELED :";U
320 :PRINT "YOU TRAVELED ";T;" MILES PER HOUR"
330 :GOTO 130
340 : REM              INPUT SUBROUTINE
350 : REM
360 :INPUT "ENTER CURRENT ODOMETER :";O
370 :INPUT "ENTER CURRENT HOUR";X
380 :INPUT "ENTER CURRENT MIN.";Z
390 :Y=X-H:W=Z-M
400 :Y=Y*60+W
410 :Y=Y/60
420 :U=O-B
430 :U=INT(U)
440 :T=INT(U/Y)
450 :N=D-U:P=N/T:N=INT(P):P=X+N
460 :IF P>24 P=P-24
470 :RETURN
480 : REM              CALCULATE MPG
490 : REM
500 :IF F=0 GOTO 540
510 :INPUT "GALLONS PUT IN TO FILL  ";K
520 :J=V
530 :INPUT "CURRENT ODO READING";O
540 :U=O-Q
550 : Q=O
560 :IF K=0 GOTO 580
570 :L=U/K
580 :PRINT "CURRENT MPG=";L
590 :GOTO 130
600 : REM              CALCULATE GALLONS REMAINING
610 : REM
620 : IF F=0 GOTO 640
630 : INPUT "ENTER CURRENT ODO READING";O
640 : S=O-Q
650 : I=S/L
660 : R=J-I
670 :PRINT "GALLONS LEFT :";R
680 : E=R*L
690 :PRINT "ENOUGH FOR MILES :";E
700 :GOTO 130
```

WE WILL NOT BE UNDERSOLD

DISK DRIVES



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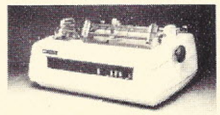

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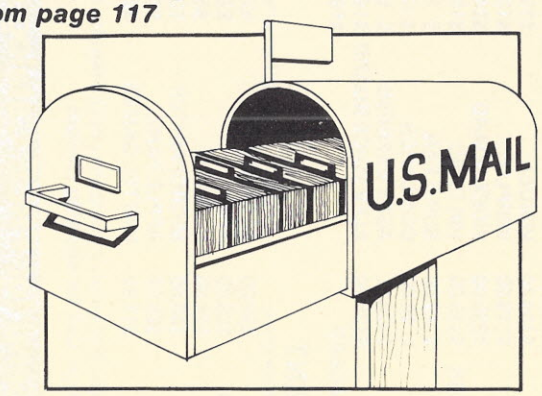
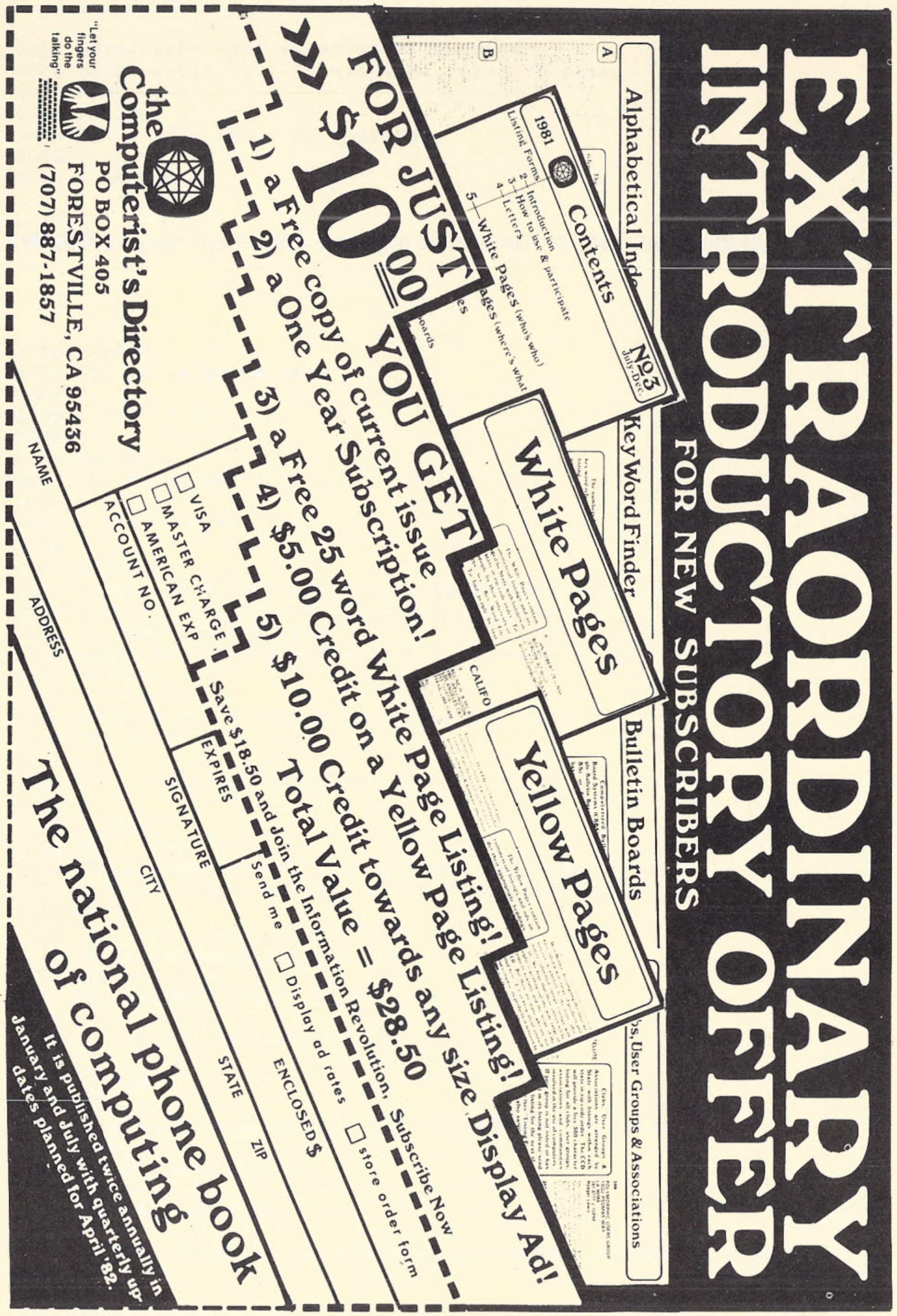
Sort-Purge-Merge Program

Continued from page 117



Listing 1. The Sort-Merge program

```
0006 :
0010 STRING= 20::Length of each string
0012 DIM S(255,2),Z(6),R(6)
0014 HOME
0020 PRINT TAB(15);"SORT-PURGE-MERGE PROGRAM"
0021 PRINT
0022 PRINT TAB(5);"This will sort by zip code, in ascending order,"
0024 PRINT "the mail list data file that is in Drive #B."
0026 PRINT :PRINT TAB(10);
0028 INPUT "Is that what you want  (Y/N) ",Q$
0030 IF Q$="y" THEN Q$="Y"
0034 IF Q$<>"Y" PRINT "Bye!":END
0040 OPEN #10,1:MAIL.DAT
0060 OPEN #1,1:INFORM.DAT
0062 READ #1,N1,N2,N3,N4,N5,N6
0064 CLOSE #1
0066 LET R = N1 ::  # of records used - some may be empty
0068 : N2 =     Sort flag - if <> 0 then sort is needed
0070 : N3 to N6 are spares
0072 :
0080 IF N2 = 0 PRINT "SORT NOT NEEDED.":END
0082 PRINT
0090 INPUT "When you are ready press 'RETURN' ",Q$
0099 :
0100 : Collecting a few variables
0101 :
0110 GOSUB 4000::How many arrays to use.
0199 :
0200 : Main routine for sorting
0201 :
0210 PRINT "There are ";S;"arrays to deal with."
0212 PRINT "There are ";R ;"records to sort and/or purge."
0214 PRINT "Filling","Sorting","Saving"
0218 LET N=0
0220 FOR F=1 TO S
0222 PRINT "#";F;
0230 GOSUB 1000::Fill array
0232 PRINT ,"#";F;
0240 GOSUB 2000::Sort array
0242 PRINT ,"#";F;
0250 GOSUB 3000::Save array in sequential file
0252 PRINT
0260 IF F1=3 THEN 280::End of MAIL.DAT reached? (See line # 1022)
0270 NEXT F
0280 IF C1<>R THEN R=C1:GOSUB 4000::Might have purged some records
0290 PRINT N1-C1;"records were purged."
0299 :
0300 : Merge
0301 :
0310 PRINT
0320 PRINT "Now to merge the ";S;"files."
0330 LET F=S:N=0
0340 GOSUB 7000::Get ready
0350 GOSUB 7100::Main merge routine
0360 PRINT
0399 :
0400 : Update INFORM.DAT
0401 :
0410 OPEN #0,1:INFORM.DAT
0420 SCRATCH #0
0430 LET N2=0::No sort needed
0440 WRITE #0,C1,N2,N3,N4,N5,N6
0450 CLOSE #0
0499 :
0500 : Clean up disk
0501 :
0510 PRINT "Deleting some temporary files."
0520 FOR X=1 TO F
0530 CLOSE #X
0540 LET S$="SEQ"+STR$(X)
0550 FDEL S$
0560 NEXT X
0599 :
0600 : Transfer back to Disk #B
0601 :
0610 PRINT "Restoring mail list to Disk #B."
0620 LET N=0
0630 LET N=N+1
0640 IF N > C1 THEN 690::Finished transferring
0650 LET K=11:RECNO #K = N:GOSUB 9000::Get
0660 LET K=10:RECNO #K = N:GOSUB 9100::Put
0670 IF IMOD(N,50)=0 P.N;::Tell operator its really working
0680 GOTO 630
0690 PRINT
0699 :
0900 : Finis
0901 :
0910 PRINT
0920 PRINT "# now on mail list";TAB(30);C1
0930 PRINT "# initially on mail list";TAB(30);N1
0940 PRINT "# OF unoccupied slots";TAB(30);RSIZE #10-C1
0990 END
0999 :
1000 : Fill array
1001 :
1010 LET X1=0::Counter for items in this array
1012 LET K=10::Data File #
```




```
1020 LET N=N+1::  N is record pointer to mail.dat
1022 IF N > R THEN F1=3:GOTO 1090::We exceeded # in the file
1030 RECNO #K=N:GOSUB 9000::Get next record
1040 GOSUB 5000::Test empty name slot
1050 IF F1=1 THEN 1020::Empty slot - skip it
1060 LET X1 = X1 + 1::Counter for # in this array
1070 LET S(X1,1)=A:S(X1,2)=N::Save zip code and record # pointer
1072 LET C1=C1+1::Counter for good records
1074 IF X1 >= 255 THEN 1090::This array is full
1076 GOTO 1020
1090 RETURN
1099 :
2000 : SORT   * SHELL-METZNER *
2001 :
2002 : X1=# TO SORT
2003 :
2010 LET M=X1:M1=X1
2015 LET M=INT(M/2)
2020 IF M=0 THEN 2090
2025 LET J=1:K=M1-M
2030 LET I=J
2035 LET L=I+M
2040 IF S(I,1)<=S(L,1) THEN 2075::Don't SWAP
2045 LET S1=S(I,1):S2=S(I,2)
2050 LET S(I,1)=S(L,1):S(I,2)=S(L,2)
2055 LET S(L,1)=S1:S(L,2)=S2
2060 LET I=I-M
2065 IF I<1 THEN 2075
2070 GOTO 2035
2075 LET J=J+1
2080 IF J>K THEN 2015
2085 GOTO 2030
2090 RETURN
2099 :
3000 : Save Array F
3001 :
3010 LET S$="SEG"+STR$(F)
3020 OPEN #1,S$
3030 SCRATCH #1
3040 FOR X=1 TO X1
3050 WRITE #1,S(X,1),S(X,2)
3060 NEXT X
3070 CLOSE #1
3090 RETURN
3099 :
4000 : Establish # of arrays
4001 :
4012 IF R>1 IF R<=255 THEN S=1
4014 IF R>255 IF R<=2*255 THEN S=2
4016 IF R>2*255 IF R<=3*255 THEN S=3
4018 IF R>3*255 IF R<=4*255 THEN S=4
4020 IF R>4*255 IF R<=5*255 THEN S=5
4022 IF R>5*255 IF R<=6*255 THEN S=6
4090 RETURN
4099 :
5000 : Purge Section
5001 :
5010 LET F1=0::Assume name field is filled
5020 IF A$="" THEN F1=1::A deleted record
5090 RETURN
```

```
5099 :
7000 : Open spare file and read first records of sorted files
7001 :
7010 OPEN #11,MAIL.DAT
7020 FOR X=1 TO F
7022 LET S$="SEQ"+STR$(X)
7030 OPEN #X,S$
7040 READ #X,Z(X),R(X)::Zip Code and Record location
7050 NEXT X
7090 RETURN
7099 :
7100 : Find the smallest zip code
7101 :
7110 LET L=999998:L2=0::L2 is flag for done
7120 FOR X=1 to F
7130 IF Z(X)=999999 THEN L2=L2+1
7140 IF Z(X)<L THEN L=Z(X):L1=X
7150 NEXT X
7160 IF L2=F THEN 7190::All files have been merged
7170 GOSUB 7200::Write L1 to #11 and get next record
7172 GOTO 7110
7190 RETURN
7199 :
7200 : L1 points to next record
7201 :
7210 LET K=10
7212 RECNO #K=R(L1):GOSUB 9000::Get THE record
7214 LET N=N+1
7220 LET K=11
7222 RECNO #K=N:GOSUB 9100::Save in temporary file
7228 IF IMOD(N,50)=0 PRINT N;
7230 READ #L1,Z(L1),R(L1)::Get the next record
7240 IF STATUS #L1=6 THEN Z(L1)=999999::Hit the end-of-file
7290 RETURN
7299 :
9000 : Get from #K
9001 :
9010 GET #K,A$,B$,C$,D$,A
9090 RETURN
9099 :
9100 : Put to #K
9101 :
9110 PUT #K,A$,B$,C$,D$,A
9190 RETURN
```

Listing 2. This will create the files necessary to test the program.

```
0001 : CREATE.ML
0002 :
0006 LET S=20::LENGTH OF STRINGS
0008 STRING= S
0010 HOME
0012 PRINT "This will create data files to test"
0014 PRINT "the sort-purge-merge program."
0020 INPUT "How many records ",R
0030 LET B=(S+1)*4+6 ::BYTES/RECORD
0032 LET Z$="MAIL.DAT"
0034 IF FCHK Z$=0 THEN FDEL Z$
0040 CREATE #10,Z$,R,B
0042 LET Z$="1:"+Z$
0044 IF FCHK Z$=0 THEN FDEL Z$
0050 CREATE #11,Z$,R,B
0060 FOR X=1 TO R STEP 1
0070 RECNO #11=X
0080 LET A=R-X+1
0090 LET A$="NAME"+STR$(A)
0100 PUT #11,A$,B$,C$,D$,A
0110 NEXT X
0200 OPEN #1,1:INFORM.DAT
0210 SCRATCH #1
0220 WRITE #1,R,1,0,0,0,0
0230 CLOSE #1
0990 END
```

Listing 3. This will allow you to verify the data in MAIL.DAT.

```
0001 : READ.ML
0002 :
0010 HOME
0012 PRINT "This will read MAIL.DAT in drive #B."
0014 PRINT
0016 STRING= 20::STRING LENGTH
0020 OPEN #10,1:MAIL.DAT
0022 LET R=RSIZE #10
0030 PRINT "REC. #","NAME","ZIP CODE"
0032 FOR X=1 TO R
0034 RECNO #10=X
0040 GET #10,A$,B$,C$,D$,A
0050 PRINT X,A$,A
0052 NEXT X
0990 END
```

Listing 4. This will fill MAIL.DAT with real 5-digit zip codes.

```
0001 : FILL.ML
0002 :
0010 STRING= 20
0020 OPEN #10,1:MAIL.DAT
0030 LET R=RSIZE #10
0100 FOR X=1 TO R
0110 LET A=((99999-10000+1)*RND+10000)
0112 LET A=INT(A)
0120 LET A$="NAME"+STR$(A)
0130 RECNO #10=X
0140 PUT #10,A$,B$,C$,D$,A
0150 IF IMOD(X,50)=0 P.X;
0190 NEXT X
```

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Program listing

```
                 ;MODEM CONTROL PACKAGE  -       TERMINAL PROCESSOR

0000 =           BOOT     EQU      0        ;SYSTEM WARM BOOT
0005 =           BDOS     EQU      5        ;BDOS ENTRY POINT
005C =           FCB      EQU      5CH      ;FILE CONTROL BLOCK
0080 =           TBUFF    EQU      80H      ;DISK BUFFER
                 ;
0003 =           MSTAT    EQU      3        ;MODEM STATUS PORT
0002 =           MDATA    EQU      2        ;MODEM DATA PORT
0002 =           MASKI    EQU      2        ;MODEM INPUT READY MASK
0001 =           MASKO    EQU      1        ;MODEM OUTPUT READY MASK
                 ;
0000 =           CTLCH    EQU      0        ;COMMAND MODE CHARACTER (0=NULL)
                 ;
0100                      ORG      100H
0100 C30102               JMP      START    ;NOW GO BEGIN
0103 3E3E205465STMSG      DB       '>> Terminal Program - Version 2.0',13,10,0
0127 00          CBUFF    DB       0
0200                      ORG      200H
```

```
                 ;
028C CD8202      MODEMI   CALL     MODEMS   ;GO GET INPUT STATUS
028F CA8C02               JZ       MODEMI   ;WAIT FOR READY
0292 DB02        MODINP   IN       MDATA    ;GET MODEM CHARACTER
0294 E67F                 ANI      7FH      ;STRIP PARITY BIT
0296 C9                   RET

0297 DB03        MODEMO   IN       MSTAT    ;GET MODEM STATUS
0299 00                   NOP               ;(CMA IF ACTIVE LOW)
029A E601        MTBE1    ANI      MASKO    ;MASK FOR SEND BIT
029C CA9702               JZ       MODEMO   ;WAIT FOR READY
029F 79                   MOV      A,C      ;GET CHARACTER TO OUTPUT
02A0 D302        MDATAO   OUT      MDATA    ;OUTPUT TO MODEM
02A2 FE0D                 CPI      13       ;NEED DELAY IS CRLF
02A4 D0                   RNC
02A5 CDD102               CALL     DELAY
02A8 CDD102               CALL     DELAY
02AB C9                   RET
                 ;
                 ;  CHECK FOR ANY INPUT ON CONSOLE OR MODEM OR SEND BUFFER

02AC 3AE605      BSIN     LDA      MODESW   ;SEND BUFFER READY
02AF E601                 ANI      1
02B1 3E00                 MVI      A,0
02B3 C8                   RZ
02B4 2F                   CMA
02B5 C9                   RET


02B6 CDB602      CSIN     CALL     CSIN     ;FIX TO POINT TO BIOS CONSOLE STATUS
02B9 B7                   ORA      A        ;00=NOT READY    FF=READY
02BA C9                   RET               ;RETURN FROM CONST.

                 ; READ A CHARACTER FROM SEND BUFFER
                 ;
02BB CDD102      BDIN     CALL     DELAY
02BE 2AE905               LHLD     CURPTR   ;GET CURRENT POINTER TO BUFFER
02C1 7C                   MOV      A,H
02C2 3D                   DCR      A
02C3 CCE102               CZ       RDNXT
02C6 7E                   MOV      A,M
02C7 23                   INX      H
02C8 22E905               SHLD     CURPTR
02CB FE1A                 CPI      1AH      ;IS IT EOF
02CD CAF402               JZ       CLOSES
02D0 C9                   RET
                 ;
02D1 E5          DELAY    PUSH     H
02D2 2AE705               LHLD     SOSLOW ;USED TO SLOW DOWN THINGS
02D5 E3          DELAY1   XTHL
02D6 E3                   XTHL
02D7 2D                   DCR      L
02D8 C2D502               JNZ      DELAY1
02DB 25                   DCR      H
02DC C2D502               JNZ      DELAY1
02DF E1                   POP      H
02E0 C9                   RET
                 ;
02E1 115C00      RDNXT    LXI      D,FCB    ;READ NEXT RECORD
02E4 0E14                 MVI      C,20
02E6 CD0500               CALL     BDOS
02E9 218000               LXI      H,TBUFF
02EC 22E905               SHLD     CURPTR
02EF B7                   ORA      A        ;CHECK FOR GOOD READ
02F0 C8                   RZ
02F1 361A                 MVI      M,1AH
02F3 C9                   RET

02F4 AF          CLOSES   XRA      A
02F5 32E605               STA      MODESW
```

```
0200 00        STACK   DB      0
               ;
0201 00        START   NOP             ;MODEM INITIALIZATION
0202 00                NOP             ;THE VARIOUS UARTS ARE
0203 00                NOP             ; INITIALIZED HERE
0204 00                NOP
0205 00                NOP
0206 00                NOP
               ;
0207 2A0100            LHLD    1       ;GET WARM BOOT ADDRESS AS BASE OF BIOS+3
020A 110300            LXI     D,3
020D 19                DAD     D
020E 22B702            SHLD    CSIN+1  ;SET CONSOLE STATUS CHECK ADDRESS
0211 19                DAD     D
0212 22FF02            SHLD    CDIN+1  ;SET CONSOLE INPUT ADDRESS
0215 210301            LXI     H,STMSG ;SAY HELLO
0218 CDCB03            CALL    PMSG
021B 2A0600            LHLD    6       ;GET BDOS ADDRESS
021E 11FAF6            LXI     D,-906H ;BACK OFF TO BEGINNING OF CCP
0221 19                DAD     D
0222 223007            SHLD    HIADDR  ;KEEP TRACK OF UPPER LIMIT
               ;
               ;       THE MAIN LOOP WHERE ALL THE WORK IS DONE
               ;
0225 310002    TERM    LXI     SP,STACK
0228 AF                XRA     A
0229 32E605            STA     MODESW
022C CDD803            CALL    CCRLF
022F CD9202            CALL    MODINP  ;CLEAR THE BUFFER
0232 CDB602    TERMA   CALL    CSIN    ;WAIT FOR ANY INPUT
0235 C26002            JNZ     TERMO
0238 CDAC02            CALL    BSIN
023B C25A02            JNZ     TERMS

023E CD8202            CALL    MODEMS
0241 CA3202            JZ      TERMA
0244 CD9202    TERMI   CALL    MODINP  ;GET MODEM INPUT
0247 B7                ORA     A       ;IGNORE NULLS
0248 CA3202            JZ      TERMA
024B 4F                MOV     C,A
024C 3AE605            LDA     MODESW  ;CHECK FOR RECEIVE
024F FE02              CPI     2
0251 CC2204            CZ      BDOUT   ;CHAR TO BUFFER
0254 CDDF03            CALL    COUT    ;OUTPUT TO CONSOLE
0257 C33202            JMP     TERMA
025A CDBB02    TERMS   CALL    BDIN    ;GET BUFFER CHARACTER
025D C36302            JMP     TERMOA  ;SEND IT OUT
0260 CDFE02    TERMO   CALL    CDIN    ;GET CONSOLE DATA INPUT
0263 4F        TERMOA  MOV     C,A
0264 CD9702            CALL    MODEMO  ;SEND IT OUT MODEM
0267 3AE505            LDA     ECHOSW  ;WANT TO SEE WHATS GOIN ON
026A E601              ANI     1
026C C4DF03            CNZ     COUT
026F 79                MOV     A,C
0270 FE0D              CPI     0DH
0272 C23202            JNZ     TERMA
0275 3AE405            LDA     CRLFSW  ;ADD LF IF CR & AUTO LF
0278 E601              ANI     1
027A CA3202            JZ      TERMA
027D 3E0A              MVI     A,0AH
027F C36302            JMP     TERMOA
               ;
0282 DB03      MODEMS  IN      MSTAT   ;GET MODEM STATUS
0284 00                NOP             ;(CMA IF ACTIVE LOW)
0285 E602      MRDY1   ANI     MASKI   ;MASK FOR RECEIVE BIT
0287 3E00              MVI     A,0     ;ASSUME NOT READY
0289 C8                RZ              ;ZERO FLAG SET=NOT READY
028A 2F                CMA             ;FF=READY TO CP/M
028B C9                RET
```

```
02F8 CD5804            CALL    FCLOSE
02FB 3E1A              MVI     A,1AH
02FD C9                RET
02FE CDFE02    CDIN    CALL    CDIN    ;FIX TO POINT TO BIOS CONSOLE INPUT
0301 FE00              CPI     CTLCH   ;LOOK OUT FOR COMMAND (CTL-@)
0303 CA0F03            JZ      COMMAND
0306 FEE1              CPI     0E1H    ;61H=LOWER CASE FOLD  E1H=NO FOLD
0307 =         UPCSW   EQU     $-1
0308 D8                RC
0309 FE7B              CPI     7BH
030B D0                RNC
030C E65F              ANI     5FH     ;FORCE TO UPPER CASE
030E C9                RET
               ;
               ;       CONSOLE COMMAND PROCESSOR
030F 21EB05    COMMAND LXI     H,COMMSG
0312 CDCB03            CALL    PMSG
0315 CDFE02            CALL    CDIN    ;GET COMMAND
0318 F5                PUSH    PSW     ;SAVE THE COMMAND
0319 4F                MOV     C,A
031A CDDF03            CALL    COUT    ;ECHO COMMAND
031D F1                POP     PSW
031E FE43              CPI     'C'     ;FORCE CLOSE FILES
0320 CA7103            JZ      CLOSEF
0323 FE44              CPI     'D'     ;CHANGE DELAY
0325 CA8803            JZ      NEWDELA
0328 FE45              CPI     'E'     ;TO SEE IT AT THIS TERMINAL, ECHO
032A CA9803            JZ      ECHO
032D FE4C              CPI     'L'     ;TOGGLE AUTO LINEFEED SWITCH
032F CAA903            JZ      AUTOL
0332 FE50              CPI     'P'     ;PRINT ANYTHING TO TERMINAL
0334 CABA03            JZ      TLIST
0337 FE51              CPI     'Q'     ;QUIT AND RETURN TO CP/M
0339 CA5403            JZ      QUIT
033C FE53              CPI     'S'     ;SEND <FILE>.<EXT>
033E CAB605            JZ      SEND
0341 FE52              CPI     'R'     ;RECEIVE <FILE>.<EXT>
0343 CA8C05            JZ      RECV
0346 FE55              CPI     'U'     ;UPPER CASE TOGGLE
0348 CA8804            JZ      UPCASE
034B 21E306    BADCMD  LXI     H,BADCMSG
034E CDCB03            CALL    PMSG
0351 C3FE02            JMP     CDIN
               ;
0354 219B06    QUIT    LXI     H,QMSG
0357 CDCB03            CALL    PMSG
035A 3AE605            LDA     MODESW  ;SEE IF ANY FILES OPEN
035D FE01              CPI     1       ;0=NONE OPEN  1=SENDING  2=RECEIVING
035F DA0000            JC      BOOT
0362 C26B03            JNZ     QCLOSR
0365 CD5804            CALL    FCLOSE
0368 C30000            JMP     BOOT    ;NOW REBOOT
               ;
036B CD3B04    QCLOSR  CALL    CLOSER
036E C30000            JMP     BOOT
               ;
0371 213906    CLOSEF  LXI     H,CMSG
0374 CDCB03            CALL    PMSG

0377 3AE605            LDA     MODESW
037A FE01              CPI     1
037C DA4B03            JC      BADCMD
037F C23B04            JNZ     CLOSER
0382 CD5804            CALL    FCLOSE
0385 C32502            JMP     TERM
               ;
0388 214606    NEWDELA LXI     H,DMSG  ;CHANGE DELAY SPEED
038B CDCB03            CALL    PMSG
038E 2AE705            LHLD    SOSLOW
0391 24                INR     H
```

```
0392 22E705           SHLD    SOSLOW
0395 C33202           JMP     TERMA
                ;
0398 216206     ECHO  LXI     H,ECMSG
039B CDCB03           CALL    PMSG
039E 3AE505           LDA     ECHOSW
03A1 EE01             XRI     1
03A3 32E505           STA     ECHOSW
03A6 C33202           JMP     TERMA
                ;
03A9 216F06     AUTOL LXI     H,LFMSG
03AC CDCB03           CALL    PMSG
03AF 3AE405           LDA     CRLFSW
03B2 EE01             XRI     1
03B4 32E405           STA     CRLFSW
03B7 C33202           JMP     TERMA
                ;
03BA 218D06     TLIST LXI     H,PFMSG
03BD CDCB03           CALL    PMSG
03C0 3AE305           LDA     PRTSW     ;TOGGLE THE PRINT FLAG
03C3 EE01             XRI     1
03C5 32E305           STA     PRTSW
03C8 C33202           JMP     TERMA
                ;
                ;
                ; WRITE A CHARACTER TO THE CONSOLE DEVICE AND MODEM
                ;

03CB 4E         PMSG  MOV     C,M       ;PRINT MSG AT (H,L) TILL 00
03CC 23               INX     H
03CD 79               MOV     A,C
03CE B7               ORA     A
03CF C8               RZ
03D0 E5               PUSH    H
03D1 CDDF03           CALL    COUT
03D4 E1               POP     H
03D5 C3CB03           JMP     PMSG

03D8 0E0D       CCRLF MVI     C,0DH
03DA CDDF03           CALL    COUT
03DD 0E0A             MVI     C,0AH
03DF C5         COUT  PUSH    B
03E0 D5               PUSH    D
03E1 E5               PUSH    H

03E2 79               MOV     A,C
03E3 FE20             CPI     ' '
03E5 D20604           JNC     COUTOK
03E8 FE08             CPI     08H       ;BACKSPACE
03EA CA0604           JZ      COUTOK
03ED FE0D             CPI     0DH       ;CARRIAGE RETURN
03EF CA0604           JZ      COUTOK
03F2 FE0A             CPI     0AH       ;LINE FEED
03F4 CA0604           JZ      COUTOK
03F7 FE09             CPI     09H       ;TAB
03F9 CA0604           JZ      COUTOK
03FC 41               MOV     B,C
03FD 0E5E             MVI     C,'^'
03FF CDDF03           CALL    COUT
0402 78               MOV     A,B
0403 F640             ORI     40H
0405 4F               MOV     C,A
0406 59         COUTOK MOV    E,C
0407 0E02             MVI     C,2       ;WRITE TO CONSOLE
0409 CD0500           CALL    BDOS
040C E1               POP     H
040D D1               POP     D
040E C1               POP     B
040F 3AE305           LDA     PRTSW     ;CHECK FOR PRINT ECHO
0412 E601             ANI     1
```

```
046C 2AE905     BLDLUP LHLD   CURPTR
046F 7E               MOV     A,M
0470 12               STAX    D
0471 FE1A             CPI     1AH
0473 C8               RZ
0474 23               INX     H
0475 22E905           SHLD    CURPTR
0478 13               INX     D
0479 05               DCR     B
047A C26C04           JNZ     BLDLUP
047D C9               RET

047E 115C00     WRTREC LXI    D,FCB
0481 0E15             MVI     C,21      ;WRITE A RECORD
0483 CD0500           CALL    BDOS
0486 B7               ORA     A         ;SUCCESSFUL WRITE
0487 C9               RET


0488 21CB06     UPCASE LXI    H,UMSG
048B CDCB03           CALL    PMSG
048E 3A0703           LDA     UPCSW
0491 EE80             XRI     80H
0493 320703           STA     UPCSW
0496 C3FE02           JMP     CDIN


0499 215C00     GETFIL LXI    H,FCB
049C 0621             MVI     B,33
049E 3600       GTFL00 MVI    M,0
04A0 23               INX     H
04A1 05               DCR     B
04A2 C29E04           JNZ     GTFL00
04A5 060B             MVI     B,11
04A7 215D00           LXI     H,FCB+1
04AA 3620       GTFL01 MVI    M,' '
04AC 23               INX     H
04AD 05               DCR     B
04AE C2AA04           JNZ     GTFL01
04B1 215000           LXI     H,50H     ;SET BUFF LEN AND CONTENT
04B4 222701           SHLD    CBUFF
04B7 112701           LXI     D,CBUFF
04BA 0E0A             MVI     C,10      ;READ INPUT BUFFER
04BC CD0500           CALL    BDOS
04BF 3A2801           LDA     CBUFF+1
04C2 112901           LXI     D,CBUFF+2
04C5 47               MOV     B,A       ;GET BUFFER LENGTH
04C6 FE0F             CPI     15        ;14 IS MAX
04C8 D28005           JNC     EROPEN
04CB FE01             CPI     1
04CD DA8005           JC      EROPEN
04D0 CAF804           JZ      GTFL1
04D3 2A2901           LHLD    CBUFF+2 ;GET 1ST 2 CHARS
04D6 7C               MOV     A,H
04D7 FE3A             CPI     ':'
04D9 C2F804           JNZ     GTFL1
04DC 1600             MVI     D,0
04DE 7D               MOV     A,L
04DF E65F             ANI     5FH       ;FORCE TO UPPER CASE
04E1 1E00             MVI     E,0       ;ASSUME DRIVE A
04E3 FE42             CPI     'B'
04E5 C2EA04           JNZ     GTFL0
04E8 1E01             MVI     E,1       ;SET FOR DRIVE B
04EA 0E0E       GTFL0 MVI     C,14      ;SELECT DISK DRIVE
04EC CD0500           CALL    BDOS
04EF 3A2801           LDA     CBUFF+1
04F2 3D               DCR     A
04F3 3D               DCR     A
04F4 47               MOV     B,A
```

```
0414 C8                 RZ
0415 C5         PLIST   PUSH    B
0416 D5                 PUSH    D
0417 E5                 PUSH    H
0418 59                 MOV     E,C
0419 0E05               MVI     C,5
041B CD0500             CALL    BDOS
041E E1                 POP     H
041F D1                 POP     D
0420 C1                 POP     B
0421 C9                 RET

0422 2AE905     BDOUT   LHLD    CURPTR  ;FILL THE BUFFER
0425 71                 MOV     M,C
0426 23                 INX     H
0427 3A3107             LDA     HIMEM
042A BC                 CMP     H
042B DA3504             JC      BDOUTC
042E 22E905             SHLD    CURPTR
0431 79                 MOV     A,C
0432 FE1A               CPI     1AH     ;IS IT EOF
0434 C0                 RNZ
0435 CD3B04     BDOUTC  CALL    CLOSER
0438 C32502             JMP     TERM

043B 2AE905     CLOSER  LHLD    CURPTR
043E 361A               MVI     M,1AH   ;MAKE SURE OF EOF
0440 213207             LXI     H,FBUFF
0443 22E905             SHLD    CURPTR
0446 CD6704     WRTNXT  CALL    BLDREC
0449 CD7E04             CALL    WRTREC
044C C25804             JNZ     FCLOSE
044F 2AE905             LHLD    CURPTR
0452 7E                 MOV     A,M
0453 FE1A               CPI     1AH
0455 C24604             JNZ     WRTNXT
0458 0E10       FCLOSE  MVI     C,16    ;CLOSE FILE
045A 115C00             LXI     D,FCB
045D CD0500             CALL    BDOS
0460 21FD06             LXI     H,CLMSG
0463 CDCB03             CALL    PMSG
0466 C9                 RET

0467 118000     BLDREC  LXI     D,TBUFF
046A 0680               MVI     B,80H
```

```
04F5 112B01             LXI     D,CBUFF+4
04F8 215D00     GTFL1   LXI     H,FCB+1
04FB 0E09               MVI     C,9
04FD 1A         GTFLA   LDAX    D
04FE 13                 INX     D
04FF FE2E               CPI     '.'
0501 CA1105             JZ      GTFLB
0504 77                 MOV     M,A
0505 23                 INX     H
0506 05                 DCR     B
0507 CA2205             JZ      GTFL9
050A 0D                 DCR     C
050B C2FD04             JNZ     GTFLA
050E C38005             JMP     EROPEN
0511 216500     GTFLB   LXI     H,FCB+9
0514 0E03               MVI     C,3
0516 1A         GTFLC   LDAX    D
0517 13                 INX     D
0518 77                 MOV     M,A
0519 23                 INX     H
051A 05                 DCR     B
051B CA2205             JZ      GTFL9
051E 0D                 DCR     C
051F C21605             JNZ     GTFLC
0522 215D00     GTFL9   LXI     H,FCB+1
0525 0E0B               MVI     C,11
0527 7E         GTFLD   MOV     A,M
0528 FE20               CPI     ' '
052A DA8005             JC      EROPEN
052D CA5105             JZ      GTFLE
0530 FE30               CPI     '0'
0532 DA8005             JC      EROPEN
0535 FE3A               CPI     ':'
0537 DA5105             JC      GTFLE
053A FE41               CPI     'A'
053C DA8005             JC      EROPEN
053F FE5B               CPI     'Z'+1
0541 DA5105             JC      GTFLE
0544 FE61               CPI     61H
0546 DA8005             JC      EROPEN
0549 FE7B               CPI     7BH
054B D28005             JNC     EROPEN
054E E65F               ANI     5FH
0550 77                 MOV     M,A
0551 23         GTFLE   INX     H
```

```
0552 0D                  DCR     C
0553 C22705              JNZ     GTFLD
0556 CDD803              CALL    CCRLF
0559 C9                  RET

055A 115C00     MAKFIL   LXI     D,FCB
055D 0E16                MVI     C,22      ;MAKE FILE
055F CD0500              CALL    BDOS
0562 FEFF                CPI     255
0564 CA8005              JZ      EROPEN
0567 115C00     FOPEN    LXI     D,FCB
056A 0E0F                MVI     C,15      ;OPEN FILE
056C CD0500              CALL    BDOS
056F 218000              LXI     H,TBUFF
0572 22E905              SHLD    CURPTR
0575 FEFF                CPI     255
0577 C0                  RNZ
0578 3AE605              LDA     MODESW
057B FE02                CPI     2
057D CA5A05              JZ      MAKFIL
0580 211907     EROPEN   LXI     H,OPMSG
0583 CDCB03              CALL    PMSG
0586 CD4B03              CALL    BADCMD
0589 C32502              JMP     TERM

058C 21C306     RECV     LXI     H,RMSG
058F CDCB03              CALL    PMSG
0592 3AE605              LDA     MODESW
0595 B7                  ORA     A
0596 C24B03              JNZ     BADCMD
0599 3E02                MVI     A,2
059B 32E605              STA     MODESW
059E 21A606              LXI     H,DSKMSG
05A1 CDCB03              CALL    PMSG
05A4 CD9904              CALL    GETFIL
05A7 CD6705              CALL    FOPEN
05AA 3E1A                MVI     A,1AH
05AC 213207              LXI     H,FBUFF
05AF 77                  MOV     M,A
05B0 22E905              SHLD    CURPTR
05B3 C33202              JMP     TERMA

05B6 21A106     SEND     LXI     H,SMSG
05B9 CDCB03              CALL    PMSG
05BC 3AE605              LDA     MODESW
05BF B7                  ORA     A
05C0 C24B03              JNZ     BADCMD
05C3 3E01                MVI     A,1
05C5 32E605              STA     MODESW
05C8 21A606              LXI     H,DSKMSG
05CB CDCB03              CALL    PMSG
05CE CD9904              CALL    GETFIL
05D1 CD6705              CALL    FOPEN
05D4 115C00              LXI     D,FCB
05D7 0E14                MVI     C,20      ;READ FIRST RECORD
05D9 CD0500              CALL    BDOS
05DC B7                  ORA     A
05DD C28005              JNZ     EROPEN
05E0 C33202              JMP     TERMA
                ;
05E3 00         PRTSW    DB      0         ;0=NO 1=PRINT ON
05E4 00         CRLFSW   DB      0         ;0=NO AUTO LF    1=AUTO LF
05E5 00         ECHOSW   DB      0         ;0=NO ECHO  1=ECHO
05E6 00         MODESW   DB      0         ;0=NO TRANS    1=SEND    2=RECEIVE
05E7 0001       SOSLOW   DW      100H      ;USED TO SLOW DOWN BUFFER SEND
                ;
05E9 0000       CURPTR   DW      0         ;CURRENT POSITION IN BUFFER
05EB 0D0A3E3E20COMMSG    DB      13,10,'>> Close, Delay, Echo, Linefeed, '
060E 5072696E74          DB      'Print, Quit, Send, Receive, Uppercase'
0633 0D0A3E3E20          DB      13,10,'>> ',0
0639 6C6F736520CMSG      DB      'lose files',13,10,0
0646 656C617920DMSG      DB      'elay factor bumped by one',13,10,0
0662 63686F2074ECMSG     DB      'cho toggle',13,10,0
066F 696E652066LFMSG     DB      'ine feed (automatic) toggle',13,10,0
068D 72696E7420PFMSG     DB      'rint toggle',13,10,0
069B 7569740D0AQMSG      DB      'uit',13,10,0
06A1 656E642000SMSG      DB      'end ',0
06A6 5B3C646973DSKMSG    DB      '[<disk>:]<filename>[.<ext>] ',0
06C3 6563656976RMSG      DB      'eceive ',0
06CB 7070657220UMSG      DB      'pper case lock toggle',13,10,0
06E3 203F3F3F3FBADCMSG   DB      ' ???? - Invalid Command',13,10,0
06FD 0D0A2D2D2DCLMSG     DB      13,10,'--- File Now Closed ---',13,10,0
0719 0D0A2A2A2AOPMSG     DB      13,10,'*** OPEN ERROR ***',13,10,0
                ;
0730 00         HIADDR   DB      0         ;DW ADDRESS OF HI MEMORY
0731 00         HIMEM    DB      0         ;HI BYTE OF HIADDR
0732 1A         FBUFF    DB      1AH       ;BUFFER AREA
0733                     END
```

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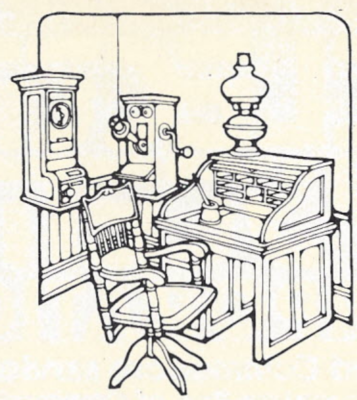

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